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SOIL FUNGI AND ROOT DISEASES.

ALTHOUGH the importance of root diseases has long been realised, less is known about this group of diseases than about almost any other because they are so difficult to study. This is especially true in the tropics, and although considerable progress has been made in the study of *Fomes lignosus* and other fungi which cause root diseases of rubber in Malaya, and of *Rosellinia pepo* on cacao in Trinidad, much still remains to be done. In an area as small as that of Trinidad and the Lesser Antilles there are at least four unexplained root diseases. Of these, the 'Red root disease complex' of the West Indian lime has received most attention, and investigations show that there is probably no definite organic cause to this 'disease' but that it is brought on by a number of complex physiological factors coupled with attacks of both fungi and insects. The root disease of grapefruit trees worked on sour orange stocks is even more obscure. Investigations have shown that neither insects nor fungi are concerned, and that here again complex physiological factors are involved. Asphyxiation of the roots by water-logging of the soil will undoubtedly produce a disease with identical symptoms, but this explanation will only fit the facts in a small number of instances. The cause of the others is at present quite unknown. Considerable damage is being done at present in Trinidad to the Immortelles (*Erythrina micropteryx*) used as cacao shade trees, by a disease attributed to *Calostilbe striispora*, and in several areas the Tonka bean (*Dipteryx odorata*) trees are dying of an unexplained root disease similar in its appearance to that of the grapefruit.

Root diseases, whose cause is known but which cannot be controlled, include the Panama disease of bananas, caused by *Fusarium cubense*, and the wilt diseases of tomatoes, Sunn hemp (*Crotalaria juncea*) and other annual crops whose cause is *Fusarium lycopersici*, *Fusarium vasinfectum* or other species of *Fusarium*. It is evident therefore that there is plenty of scope for further work on these diseases in the West Indies, and in this connection the recent work of Garrett* at Rothamsted and in Australia is of considerable interest. According to Garrett, in the last few years the old pure culture methods used in the study of root diseases have largely been superseded by methods based on the study of the ecology and edaphic relationships of the plants concerned. It

* I.A.B. Tech. Comm. No. 38, 1939 and other papers

was thought at one time that many of the soil fungi which cause root disease were able to persist indefinitely in the soil in the absence of their host plants by living on soil organic matter. Experience has shown, however, that in many instances the primary parasite is followed by a succession of other fungi and soil micro-organisms, and it is probable that the more highly specialised root-infecting fungi are confined to the living roots or other underground parts of their host plants, and are unable to compete for food material with the secondary parasites and saprophytes which develop in the infected plant tissues. The root infecting fungi can be classified ecologically as *soil inhabitants* and *soil invaders*. The soil inhabitants are primitive or unspecialised parasites with a wide host range; they are distributed throughout the soil and their parasitism is incidental to their saprophytic existence. The soil invaders, to which class the majority of root infecting fungi belong, are more highly specialised parasites and are more closely associated with their host plants. In the continued absence of the host plant such fungi die out in the soil as they are unable to compete with the soil saprophytes.

Garrett has summarised the methods used for the control of root diseases under five heads. The first method, the use of resistant varieties, is ideal when attainable. This method and that of seed treatment by fungicides probably save the agricultural industry of the world more money than all the other methods for the control of soil-borne fungus diseases put together. His second method, that of plant sanitation, is often attempted but will inevitably fail unless thoroughly carried out. This method involves the disposal of infected material after the crop by turning it into the soil, burning, and so on; and the prevention of dispersal of the fungus by planting operations, cultural operations, stock, manure, wind, water or insects. While examples of the spread of disease by any of these methods can be found, their importance is probably often over-estimated. Thirdly, under certain conditions pathogenic fungi can be eliminated from the soil. Fungi persist in the soil as mycelium, thin-walled conidia, thick-walled resting spores, or as sclerotia. They can be eliminated by fungicides or heat, by mechanical methods, and by crop rotation or biological control. Partial soil sterilization by heat or fungicides is of importance in seed-beds, glass-houses, and market gardens, where an effective rotation is generally impossible, but is impracticable under field conditions. Mechanical methods are used especially in the control of the root diseases of tree crops in the tropics. Crop rotation is one of the oldest methods of controlling soil-borne diseases and can only succeed where a specialised parasite is concerned. Obviously it will not control a fungus with a wide host range or highly resistant resting spores. Biological control depends on the mutual antagonism of certain organisms. If, by altering the edaphic conditions, harmless fungi can be encouraged at the expense of the parasitic species, control of the disease may be accomplished. This is a very promising line of research which is being actively followed at present. The fourth method, that of the adjustment of soil conditions to check the activity of the parasite, is also of considerable importance. Soil temperature and soil moisture are only controllable to a limited extent, but soil texture and aeration, which have a particularly pronounced effect on root infecting fungi, can often be easily altered. It is true that certain weak parasites can only infect the host when it is injured by water-logging or other cause of deficient soil aeration, but the activity of pathogenic fungi is generally favoured by soils of light texture and good aeration. The importance of a well compacted soil in the control of 'take-all' disease of wheat in Australia has been realised for many years, and Reinking has shown that under certain conditions Panama disease of bananas is serious only on light-textured soils and that control of this disease is accomplished by restricting new plantings to the heavier soils. The influence of soil reaction on certain diseases is well known, but although control of such diseases by modification of soil reaction alone is not generally a practical possibility because of the highly buffered nature of the soil, more use will probably be made of this method in future as an adjunct to other plant protection methods. Lastly certain diseases can be controlled by augmenting host resistance in various ways. The further the cultivation environment is removed from the natural 'ecological optimum' the more liable is the crop to complex diseases of the type mentioned at the beginning of this article. Of importance in this connection are temperature, which may be altered by varying the date of sowing of an annual crop, water-logging, too heavy cropping, and manurial deficiencies.

Garrett's paper supports the view that a healthy plant growing in its normal environment stands the best chance of escaping disease, but emphasises the importance of many other factors which appear in the control of soil-borne fungus diseases. This group of diseases is of no less importance in the tropics than it is in temperate regions, and a detailed study of many root diseases of tropical crops is urgently required.

R.E.D.B.

NICKEL-CLAD STEEL.

Nickel-clad steel consists of a light layer of pure solid nickel permanently bonded to a heavier layer of steel. The nickel cladding has the same corrosion-resistant properties as nickel sheet, and can be welded, so that vessels suitable for many types of equipment exposed to corrosion attack can be made of this material. It is a very useful material for the construction of industrial plant, and a good number of vessels in a new London sugar refinery have been constructed of it.—(*Int. Sugar Jr.*, Vol. XLI, No. 485, p. 200, 1939.)

BRITISH WEST INDIAN ECONOMIC HISTORY IN IMPERIAL PERSPECTIVE.*

By C. Y. Shephard.

World Trade and the Discovery of America.

Before the discovery of America the most important of all trade routes was that which brought to Europe the spices, silks, ivory and precious stones of the East. When the Turks became masters of the Mediterranean in the fifteenth century, the imperative need of restoring trade with the Orient culminated in the discoveries of Columbus and Vasco da Gama. Almost simultaneously with the revelation of a new highway to the Indies *via* the Cape, came the discovery of the Americas.

The consequences were revolutionary. The old trade routes were abandoned; the Mediterranean became a backwater; the dazzling prosperity of the Italian and German cities became a thing of the past; and the future lay with those nations bordering the Atlantic. Spain and Portugal claimed a monopoly of the new trade by reason of prior discovery. This monopoly was confirmed by the Papal Bull dividing the entire unexplored and pagan world between these two great Catholic powers. Prior to the Protestant Revolt this Bull constituted an unquestionable title which no European nation dreamed of challenging.

Once the Spaniards discovered the rich mines of Mexico and Peru, the Greater Antilles were relegated to mere ports of call. The Lesser Antilles were ignored because they contained no gold or silver, were inhabited by the fierce and intractable Caribs, and were unsuitable for cattle raising.

The precious metals, gold and silver, were considered the 'backbone of peace and the sinews of war', and the vast quantities of bullion which flowed into Spain from the New World excited the envy and cupidity of every other European nation. During the latter half of the sixteenth century, French, English and Dutch privateers endeavoured to force from Spain the opportunities for trade and the wealth which Spain was unwilling to concede to persuasion. The booty with which Drake returned to England in 1573, was an astonishing revelation to the average Englishman, and encouraged many another adventurer in the hope of emulating his exploits.

The privateering wars undoubtedly contributed to the rise of England as a maritime power, but they had neither destroyed Spanish commerce nor captured her colonies. It was the successful efforts of Dutch and English sailors in European waters, and the long campaigns and sieges on the Continent that exhausted Spain. The Dutch were primarily responsible for affording the English and French an opportunity of settling in the West Indies. From 1624 to 1628 fleet after fleet poured from the Netherlands into the Caribbean, the crowning achievement being the capture of the annual treasure fleet in 1628. To Spain the loss was irreparable, and by 1630 her navy was no longer capable of resisting the settlement of other Europeans in the West Indies. From 1625 crowds of French and English colonists swarmed into the West Indies, and within 10 years the scene had changed for ever.

Early British and French Settlements.

The first permanent British settlement in the West Indies was established by Sir Thomas Warner in St. Christopher or St. Kitts, in 1623. St. Kitts tobacco was of high quality and fetched remunerative prices. In 1624 the survivors of a French ship sought refuge in St. Kitts, where they were welcomed by the English settlers who feared an overwhelming attack by the Caribs. The English and French colonist agreed to maintain peace between one another, even when their Mother Countries were at war. Within a few years the English overflowed into Nevis, Montserrat and Antigua, while the French spread to Guadeloupe and Martinique. The Dutch occupied St. Eustatius, St. Martins and Curaçao. In 1627 Courteen's men occupied Barbados. The Windward Islands were still guarded from colonisation by the Caribs. The mainland shores of the Caribbean and the Greater Antilles remained wholly in Spanish hands, but the Lesser Antilles, that had hitherto sheltered but a scanty population of Caribs, had become the homes of teeming white communities without a Spaniard among them.

Contemporary estimates of European settlers appear to be exaggerated. Barbados is said to have contained over 37,000 Englishmen in 1643. The entire cultivable area was divided into small holdings of from 5 to 30 acres, on which tobacco or cotton was produced by the manual labour of a few white settlers. By 1639, European markets had become so glutted with tobacco as to cause an alarming drop in price. In St. Kitts both French and English planters agreed to cease planting for a year, and turned to cotton and indigo, but indigo proved a failure.

Origins of the Sugar Industry.

The Dutch merchants who then practically monopolised the contraband trade of the West Indies persuaded a few individuals to try sugar cane, but neither in Martinique nor in Barbados were the first experiments successful. A deputation of enterprising Barbadian planters visited Brazil to study the long established Portuguese sugar industry and on their return the Dutch traders provided the necessary sugar house equipment on long credit. By this means modern sugar works were first introduced into Barbados in 1642. White labourers proved incapable of

* Published by courtesy of the Historical Society of Trinidad and Tobago.

performing the heavy manual tasks involved in the cultivation of sugar cane, but it was soon discovered that the work could be done effectively by negro slaves under the direction of a few overseers. These slaves the Dutch were only too eager to supply. In 1640 there were not more than a few hundred slaves in Barbados; by 1651 they numbered more than 20,000.

The introduction of sugar-cane resulted in an extraordinary and striking social change. The more astute owners bought out their neighbours, dismissed their indentured servants, and substituted slaves. The land passed quickly into the hands of a comparatively small group of magnates who rapidly amassed great fortunes. Barbados became a fertile recruiting ground for colonising expeditions to other parts of the West Indies, and no less than 12,000 whites are said to have left the island within the space of ten years. The other islands followed the example of Barbados in abandoning other crops for sugar cane and henceforth until the twentieth century the economic history of the islands is concerned almost exclusively with sugar.

The Old Colonial Policy.

About the beginning of the seventeenth century the English merchants who were engaged in foreign trade, especially with the East, developed the so-called Mercantile Theory as a protest against the crude bullionist theory. The Mercantile Theory became a fundamental maxim not of England only, but of all other commercial countries. Its most distinguished expositor was Thoman Mun whose masterpiece was entitled, "English Treasure by Forraign Trade, or the Ballance of our Forraign Trade is the Rule of our Treasure". He expressed his theory thus: "The ordinary means . . . to encrease our wealth and treasure is by *Forraign Trade*, wherein wee must ever observe this rule; to sell more to strangers yearly than wee consume of theirs in value . . . because that part of our stock which is not returned to us in wares must necessarily be brought home in treasure." (1).

England, France and Holland were excluded from the gold and silver mines of the New World, and a favourable balance of trade was the only means by which they could augment their stocks of the precious metals. England's foreign trade depended upon the sea, and it became a cardinal feature of English policy to provide every possible encouragement for shipping. Cromwell visualised schemes for the aggrandisement of British trade which were beyond the capacity of the country to accomplish. In 1651 he enacted the Navigation Ordinance which became the basis of English colonial policy for nearly two centuries. This Ordinance stipulated that the products of Asia, Africa and America might be imported into England, her colonies or dependencies only in English or colonial ships of which the master and a majority of the crew were of English nationality. European products might be exported thither only in ships belonging to England or her colonies, or to the countries in which the goods were produced. The colonies were to play their part by supplying commodities hitherto purchased from foreigners.

The Navigation Ordinance was clearly aimed at the Dutch who then enjoyed almost a monopoly of international sea-borne trade. Hitherto the English and Dutch had been allies in the cause of Protestantism, but they now became enemies on the issues of commerce and colonial power. The wars with the Dutch broke the commercial links that bound the English and French planters to the traders and merchants of the Netherlands. English cruisers in the Channel and the North Sea interrupted Dutch trade and diverted sugar cargoes to London. Planters who had previously obtained credit in Holland and France now found their backing in London, and the channels of trade were permanently diverted.

Cromwell's grandiose proposal for dividing the trade of the world between the English and Dutch was rejected by the practical Netherlanders, and in 1654 the Protector proceeded unaided with his "Western Design" to capture Spanish trade and colonies in the West Indies. The English army suffered ignominious defeat in attempting to capture Santo Domingo, and had to be content with the ill-defended and less desirable Island of Jamaica.

The Navigation Act was re-enacted at the Restoration with the addition of an important new clause. Certain enumerated colonial products such as sugar, tobacco, cotton-wool, indigo, ginger, fustic and other dye-woods, had to be shipped to England or to a British Colony. The intention and effect of this clause was to give English and colonial shipping a monopoly of the trade within the Empire, and to make England a great distributing centre for sugar and tobacco. The regulation of colonial trade was further tightened by the Staple Act of 1663 which prohibited the importation into the colonies of any European commodities that had not been laden and shipped in England. The enumerated commodities from the colonies were subject to duty when imported into England, but part of this duty was refunded on re-export to other countries. The colonists endeavoured to evade these duties by shipping direct, or *via* another British colony, to foreign markets. Parliament frustrated these tricks by the Plantation Act of 1673 which imposed export duties on enumerated commodities when leaving the colonies (1). These three Acts of Parliament—the Navigation Act (1660), the Staple Act (1663) and the Plantation Act (1673)—constituted the framework of the old colonial system.

The strict enforcement of the Navigation Ordinance necessitated the provision of slaves to the planters through English sources. A Company of Adventurers to Africa was therefore formed immediately after the Restoration to combine the

(1) "England's Treasure by Forraign Trade," by Thomas Mun, 1664. *Macmillan & Co.*, 1895.

(1) The duties were 1*s.* 6*d.* per cwt. on brown, and 5*s.* on white sugar.

individual English merchants then purchasing slaves from the Portuguese. Thus, England, West Africa and the West Indies were linked together in a great commercial chain. The growing intrusion of the English in the West African slave trade brought them again into conflict and open war with the Dutch.

Anglo-French Rivalry.

In the meantime the French and English had rapidly consolidated their colonies in the West Indies, largely at the expense of Dutch commerce. England and France were at the beginning of their rivalry for the trade of the Spanish Indies that was to dominate colonial history for more than a century. Hitherto the French and English settlers had remained allies against the Caribs, who were promised freedom in St. Vincent and Dominica, provided they refrained from attacking Europeans. In 1664, the Governor of Barbados, seeking an outlet for his surplus population, despatched over 1,000 settlers to St. Lucia to establish an organised colony. (It is of interest to note that this experiment is now being repeated.) In the next year Governor Willoughby nominated Thomas Warner, a son of Sir Thomas, as Deputy Governor of St. Vincent. The French regarded this action as a flagrant breach of the old neutrality agreement.

The ensuing war had a disastrous effect on the colonies. St. Kitts (1666), Antigua (November, 1666) and Montserrat (February, 1667) were captured and devastated by the French. Holland was drawn into the conflict and lost all her colonies, save Curaçao, and a great deal of her shipping and trade. England eventually regained mastery of the sea, and the possession of her colonies, but, with the exception of Barbados and Jamaica, the colonies had lost nearly all the progress made during the previous forty years. Every Island had lost heavily in men, and the taxation to meet the cost of the war drained capital away from the improvement of the plantations. The legacy of this war was acute hatred between the French and English colonists where there had previously been mutual tolerance and some respect.

Hitherto, the French had produced little sugar in the West Indies, but with the aid of 15,000 slaves, and the materials for 150 sugar works, which they had carried off from St. Kitts, Antigua and Montserrat, the output rapidly expanded. Within a few years the price of sugar had fallen by 50 per cent. (1). The Barbadians, then the most important of our colonists, attributed the perpendicular fall in the price of sugar to the strict enforcement of the Navigation Act, especially the clause requiring sugar intended for Europe to be shipped *via* England. They argued that forcing all their sugar on to one market would cause a glut and a further fall in prices, and begged permission to ship their produce to any market. They complained, further, that as a result of the Staple Act, they had to pay twice or thrice as much as formerly for their supplies.

At this time half the colonial sugar imported into England was re-exported to foreign countries. The additional expense of shipping *via* England unquestionably diminished the profits of the English planters, but the principal cause of the fall in price was the rapid expansion of sugar production, especially in the French colonies. The time was to come when England consumed practically all its colonial crop, and the planters enjoyed monopolistic prices far in excess of those ruling in the international market.

The remainder of the seventeenth century witnessed a complicated series of squabbles and wars between the rival claimants for Spain's trade and colonies. With the details of these conflicts we need not concern ourselves except to note that France gained from Spain the Eastern half of Hispaniola where she established the flourishing colony of St. Dominique (now Haiti). This French colony had great indirect influence at a later stage on the prosperity of the English sugar colonies.

England and France, now the great rivals for Spanish and Dutch trade in the West Indies, were soon at war again. England acquired the whole of St. Kitts, this time for good. The gains of England at the Treaty of Utrecht (1713) did not appear very substantial, but in reality her position had been enormously strengthened. Holland, her old rival and subsequent ally, was left hopelessly behind. France emerged from the war with her navy and shipping ruined. "Before that war, England was *one* of the sea powers. After it, she was *the* sea power, without any second" (1). England also gained the privilege of carrying slaves to the Spanish colonies, and, under the cover of this concession, she carried on a profitable contraband trade with the Spanish colonies.

During the next twenty years the production of sugar expanded rapidly in all the English, French, Dutch and Portuguese colonies, but especially in the French colony of St. Dominique. Sugar consumption in England was rising, principally because of the spread of the habit of tea drinking but foreign competition caused a rapid shrinkage in re-exports of colonial sugar from England to Europe. (2) The French Colonial Empire had become overbalanced on the tropical side. The

(1) Prior to 1667 the price of colonial raw sugar in England was about 40s. per cwt.: but by 1670 the price had fallen to 22s. per cwt. Beer, G. L. "The Old Colonial System". Part I, Vol. I, p. 130, n.l.

(1) Mahan. The Influence of Sea Power upon History, 1660-1783.

(2) In 1713 England exported 184,609 cwt. of raw sugar, but by 1723 exports had fallen to 63,479 cwt. Pitman, F. W. "The Development of the British West Indies 1700-1763." *Yale University Press*, 1917, p. 168.

production of rum and molasses was discouraged in the French colonies in order to protect the wine and brandy industries in the Mother Country. The British Empire was overbalanced on the temperate side, and the North American Colonies developed commerce of a considerable magnitude with the French West Indies. The price of British sugar fell alarmingly, and caused great distress in the West Indian Colonies.

Sugar Prices 1727 to 1758.*

Year.	Muscovado Sugar.		Clayed Sugar.	
Xmas to Xmas.	*s.*	*d.*	*s.*	*d.*
1727–1728	24	10¼	37	2½
1728–1729	24	5½	39	3
1729–1730	21	8½	32	4½
1730–1731	19	8¼	31	11¼
1731–1732	17	10	31	0
1732–1733	16	11¼	31	1½
1733–1734	25	8½	32	9¾
1734–1735	18	9½	31	4
1735–1736	19	5½	29	9¾
1736–1737	24	9	33	0¾
1737–1738	21	7¾	34	5¼
1738–1739	25	8¼	37	6
1739–1740	32	0½	38	6¾
1740–1741	30	5	38	7¼
1741–1742	29	1	41	1¾
1742–1743	27	3½	35	0¾
1743–1744	30	7	42	0
1744–1745	39	11	50	0¾
1745–1746	39	5	51	1
1746–1747	42	9½	55	7
1747–1748	31	7¼	50	1¼
1748–1749	28	11¾	42	8
1749–1750	27	9½	39	6
1750–1751	30	6	40	5¾
1751–1752	38	7¾	48	4¾
1752–1753	33	0	48	5¼
1753–1754	35	8¾	50	3½
1754–1755	35	8¾	49	8¼
1755–1756	34	3¼	48	10½
1756–1757	37	1	48	6
1757–1758	42	5¾	51	2¾

* Average prices per hundredweight for sugar sold at the London Custom House. Pitman, *loc. cit.*, pp. 134 and 186.

The representatives of the British sugar planters, led by Barbados, carried on an intensive political campaign which resulted in the Molasses Act of 1733. This Act imposed almost prohibitive duties on the import of foreign sugar, molasses or rum into Great Britain, Ireland, or any British Colony (1). This Legislation marks the first great triumph of the British West Indian planters in English politics, and for nearly a hundred years they wielded great power in English Parliamentary circles. The Molasses Act was intended to cripple the growing trade between North America and the French West Indies and was one of the factors which led to the revolt of the American Colonies.

The West Indian planters, elated by their success in securing the Molasses Act, and conscious of their political power, induced Parliament to remove sugar from the enumerated commodities, and gained permission to ship sugar direct to foreign ports in Europe without paying the duties formerly collected in England. The significance of this Sugar Act of 1739 lay in the power it accorded the British West Indies to restrict the supply and thereby raise the price of sugar in the British market (1). English consumers soon complained that they were compelled to pay nearly twice as much for sugar as people in Europe. The breach effected in British colonial policy in the interests of the sugar planters is indicative of the great value attached to the West Indian colonies. For many years they enjoyed monopolistic and highly profitable prices for their sugar.

The Treaty of Paris : Turning Point in Colonial History.

Jenkin's Ear War and the War of the Austrian Succession were mere incidents in the struggle for the command of the trade of the West Indies. The Treaty of Aix-la-Chapelle (1748) was recognised as a truce in the bitter rivalry between France and England and with the outbreak of the Seven Years War the issue was fairly joined. During that war English arms were everywhere successful and, at the Treaty of Paris in 1763, England was free to dictate the direction in which she would expand. The decision which she took marks a turning point in British Colonial policy.

The aim of the old Colonial policy was to create a self-sufficing commercial empire. The colonies were to be complementary to the Mother Country, and to provide employment for British ships and seamen. Of all the British overseas possessions the West Indies conformed most closely to this ideal. They provided the sugar which had previously been bought from foreigners, and made England, at one time, the great entrepot for the European sugar market. They utilised slaves which reduced the drain on the manpower of the Mother Country, provided a profitable market for the West African trading posts, and employed large numbers of British ships. They constituted a valuable market for tools, clothing and provisions, and none of their industries competed with those of England. They were admirable strategic bases from which attacks could be launched on Spanish trade and colonies in the New World. The West Indies were the most highly prized of all British overseas possessions, and they became the pampered pets of the old Colonial system.

(1) The import duties into all British Colonies were :—Sugar 5*s.* per cwt. ; rum 9*d.* per gallon ; molasses 6*d.* per gallon.

(1) With the passage of the Molasses Act the price of sugar per cwt. had recovered from 16*s.* 11¼*d.* during 1732-3 to 25*s.* 8¼*d.* during 1738-9. During 1739-40 sugar rose to 32*s.* 0½*d.* Pitman, *loc. cit.* p. 134.

Most of the American colonies were regarded with disfavour (1). They drained England of population, although the Mother Country restricted emigration to those who failed to fit in with the political, religious and economic system at home. They competed with England in the ship-building and carrying trades, and in the purchase of tropical commodities. They had little to export to Great Britain which remained primarily agricultural. Their economic development resembled that of the Mother Country far too much for it to be admired. The Southern American colonies were better esteemed because they made England the centre of the tobacco trade, and employed slaves. Newfoundland was merely a fishing establishment but was valued as a nursery for seamen and consequently a source of naval strength.

The West African trading posts were rendered valuable by the slave market of the West Indies. The East Indian trade was condemned because it necessitated the export of bullion, introduced cotton, which competed with the English woollen industry, and involved exceptionally heavy mortality.

The Treaty of Paris afforded England an opportunity of adding to her tropical colonies in which she was particularly weak. Great controversy raged in English Parliamentary circles as to whether Canada or Guadeloupe should be retained. The general consensus of public opinion was strongly in favour of adding Guadeloupe to the British Empire. In 1761, when Guadeloupe was in British possession, her exports to Great Britain had exceeded £600,000, of which sugar accounted for two-thirds. The exports from Canada to Great Britain during the same year amounted to a trivial £14,000, consisting principally of furs. Great Britain had already lost to France the European sugar market, and the British West Indies were barely able to supply the Mother Country's requirements. Burke argued that, "if we retain Guadeloupe and not Canada, we shall not sacrifice a present, real, and tangible advantage to a remote contingency". The acquisition of Guadeloupe would have enabled the West Indies to cater more adequately for the increasing British demand for sugar. The West Indian planters threw their political weight in favour of the return of Guadeloupe in order to restrict the supply and raise the price of sugar in the English market.

(1) In 1744 the West Indies were a more important market than North America for England and took goods of the value of £796,112 compared with £640,114. By 1758 North America had far outstripped the West Indies and imported goods valued at £1,832,948 compared with £877,571. The West Indies remained a more important supplier of commodities to the Mother Country and in 1758 England imported West Indian produce to the value of £1,834,036 compared with £648,688 from North America. The Southern colonies of Virginia, Maryland and Carolina supplied 90 per cent. of the goods imported by England from North America. Beer, G. L. "British Colonial Policy" 1754-1765. p. 149-151.

At the Treaty of Paris, England gained Canada and handed back Guadeloupe. In the West Indies, Great Britain received the comparatively unimportant Islands of Grenada, St. Vincent, Dominica and Tobago. Public opinion felt that the peace had sacrificed British interests, and that the Continental colonies were the chief beneficiaries of a war carried on mainly at the expense of the Mother Country.

The decision to keep Canada instead of Guadeloupe hastened the revolt of the American Colonies. Canada in British hands removed the fear of the French, which had bound the American Colonies to the Mother Country. The failure to add appreciably to British tropical possessions, and the strict enforcement of the Molasses Act, cramped the fast growing American commerce to an intolerable degree. The interests and aims of American merchants and West Indian planters were clearly incompatible, and the determination of the Mother Country to enforce all restrictions on colonial commerce led straight to revolution.

(To be concluded)

HARVESTING, DRYING AND SAMPLING DERRIS ROOT.

A New Method.

Harvesting. No effort was made to preserve the roots intact. The stems were cut off at ground level, the roots being forked up and placed in baskets and removed to a sorting shed where they were roughly cleaned and all portions of stems removed. The marketable roots, *i.e.* up to ½-inch diameter, were chopped into 6-inch lengths and sorted into two grades, fine and very fine. *Drying.* The two grades were separately dried on a kiln similar to a hot-table copra kiln, the average temperature was 140°F., and drying was complete in 3 days. During the turning on the drying kiln any adhering earth fell away. *Sampling* at random a wide degree of variance in toxic content may be formed between any two groups of 20 bales, and this variance, though less than that between plant and plant, is too wide to admit of reliance being placed on any single random sample. For this reason a definite sampling procedure should be arranged between buyer and seller preferably as to the amount to be drawn from each bale when the root is being pressed. Advantages of chopped roots are the complete absence of dust detrimental to the health of the labourers and the reduction of stem, important in view of the fact that the presence of stem has an adverse effect on the price. The alleged liability of chopped root (or of powdered root) to deteriorate in storage was not confirmed in the experiment carried out by the Department of Agriculture.—(*Imp. Bur. of Hort. and Plantation Crops*, Vol. VIII, No. 1, Abs. 216, p. 62, 1938.)

WEST INDIAN NOTES.

(Compiled by the Advisory Department, Imperial College of Tropical Agriculture.)

The Sugar Industry.

The reaping season is now nearly completed. In St. Kitts another record has been set up and the final estimate is 38,000 tons. The increased production is a reflection of the better organization of the industry following the introduction of higher yielding varieties and the application of more scientific methods of cultivation and manuring. A severe drought was experienced in the early part of the growing season of 1938, but ample rains fell in the later part of the year.

The crop in Antigua is estimated at 23,500 tons and in St. Lucia at 8,350 tons. Very considerable losses were experienced in St. Lucia by severe flooding which accompanied the unprecedented rainfall of November, 1938.

In spite of the abnormal and excessively heavy rains in the last three months of 1938 in Barbados, a record crop of 152,000 tons is estimated. In Trinidad the crop is estimated at 130,000 tons.

The eighth meeting of the Advisory Committee of the British West Indies Central Sugar Cane Breeding Station was held in Barbados from 2nd to 4th May, 1939. The representatives attending the meeting were as follows: Barbados, Dr. S. J. Saint, Director of Agriculture (Chairman of the Advisory Committee); I.C.T.A., Mr. O. T. Faulkner, Principal; Trinidad, the Hon. E. J. Wortley, Director of Agriculture; Representatives of Jamaica and the Windward Islands were unable to be present. Dr. A. E. S. McIntosh, Geneticist of the Cane Breeding Station was also present. Mr. D. M. Hanschell, Assistant Botanist to the Station, performed the duties of Secretary.

Some of the more important findings of the Committee are summarised below:—

Finance of the Station.

The Committee noted with satisfaction that Trinidad and Jamaica had agreed to increase their annual subscriptions to the Station by £200 and £300 respectively. The total sum voted by the contributing Colonies now amounts to £2,500.

Progress Report on the Work of the Station.

The Geneticist submitted a progress report on the work of the Station for the period between the seventh and eighth meetings of the Advisory Committee. The Committee were satisfied that steady progress had been made and expressed particular satisfaction at the promise shown by seedlings derived from recent nobilisation work. The Committee agreed that the investigations just concluded into the use of the Zeiss Hand Refractometer in seedling selection had given very useful information.

Extension of Nobilisation Schemes by the Importation of Further Wild Cane Material.

The Committee expressed its approval of the projected expansion in the nobilisation work by an importation of a selection of wild sugar cane species recently collected by the Government of the United States of America.

A Statement of Policy regarding the Export of New Commercial Seedlings to Foreign Countries.

The Chairman stated that in view of the promise of recently produced seedlings it was desirable that the Committee should make some definite statement of policy regarding their export to foreign countries. With a view to safeguarding the interests of the contributing colonies the Committee decided that the Chairman should not export any seedling to foreign countries until such time as its potentialities have been fully tested in the contributing colonies. The Committee further decided that the Chairman should be authorised to make a nominal charge of fifty pounds sterling for each variety exported to any foreign country excepting those that have supplied sugar cane planting material to the Station.

The Committee decided that any request for the export of planting material of seedlings bred by the Central Sugar Cane Breeding Station should be referred to the Chairman of the Advisory Committee.

The Limes Industry.

West Indian Limes Association.

An attempt has been made to encourage co-operation within the British West Indian limes industry by the proposal to form a West Indian Limes Association, the objects of which would be in general to promote in every way possible the welfare of the limes industry. Associations of growers and others interested in the cultivation of limes and in the manufacture of lime products have been formed in Trinidad and Tobago, Dominica and St. Lucia. Steps are now being taken to bring about the formation of a West Indian Limes Association, of which the three Island Associations mentioned would be the first members. It is hoped that in the near future local Limes Associations will be formed in Jamaica and other lime producing Colonies in the British Caribbean area and that they will in due course become members of the proposed West Indian Limes Association.

Marketing of Fresh Limes in the United Kingdom.

The Colonial Empire Marketing Board has offered to assist the West Indian limes industry by encouraging the sale of fresh limes in the United Kingdom. Definite proposals will not be considered until the formation of the West Indian Limes Association has been effected.

In the meanwhile the Jamaica Government has appointed a London representative of the Jamaica Marketing Division for general propaganda and sales development work for all Jamaican crops in which the Marketing Division is interested. The officer will devote most of his time this summer to increasing the sale of fresh limes in London and in the South of England.

The Jamaica Marketing Division has leased a cold storage and repacking depôt near to Battersea Bridge, London for the purpose of repacking limes into cartons for distribution in the London and South of England market. The services of the officer and the depôt organization have been offered to lime producers in the Eastern Group Colonies.

Citrus Pests Investigation.

On 23rd October, 1938, Mr. R. G. Fennah returned to St. Lucia after vacation leave, and has recently submitted the third progress report of the Citrus Pests Investigation, covering work carried out during the past six months.

The principal pests of citrus in the Colony are the weevils *Diaprepes abbreviatus* and *Diaprepes famelicus esuriens*,* and the means now being employed in the colony to reduce damage are as follows :—

(1) Reduction of the weevil population by means of the egg-parasite *Tetrastichus marylandensis*.

(2) Prevention of the annual invasion of the root system by the use of surface dressings of acid lead arsenate, or of a soil covering of bagasse and road oil.

(3) Exposure of the larger (" crown ") roots by the removal of soil from around them.

(4) Promotion of vigorous growth on the part of the host plant.

(5) Cultivation, in dense intergrowth with citrus of the cover-crop *Tephrosia candida*, which is avoided by *Diaprepes*.

In 1938 *T. marylandensis* was brought into St. Lucia from Dominica. It has a wider distribution than any of the local egg-parasites, and in Montserrat and Dominica has proved more successful than other egg-parasites in competition both on mixed egg-populations, and, as far as can be judged from much scantier data, on eggs of either species of *Diaprepes* singly. As emergence of the weevils for the current year has not yet begun, it is not possible to state whether the parasite is established.

The trials of lead arsenate and bagasse and oil dressing laid out at Union Experimental Station are being maintained. A general improvement took place in the condition of the trees on all plots in 1937, and differences in yield in the 1938 crop were not significant.

* *Diaprepes boxi*, which is known only from St. Lucia, though widely distributed through the island and occurring on citrus, is very uncommon and is not ranked as a pest.

Trees which had received the 'bare-root' treatment were kept under observation during the year. It had previously been found that trees so protected lose nothing of their stability, and that the soil below did not become dried out in the dry season. To this may be added that the presence of the excavations does not lead to water-logging at the roots, that such weeding as becomes necessary is most easily carried out by hand (thereby discouraging the use of implements among the roots), and that annual renewal of the basins is necessary only in light soils.

The promotion of rapid growth to ensure production of rootlets to counterbalance losses due to larval feeding is dependent, in the first place, on the correction of existing nutrient deficiencies in the groves. It has recently been found that in the largest citrus-growing area there is a marked deficiency of available potash, frequently combined with a deficiency of available phosphate. A more extended use of *Tephrosia candida*, which is being widely taken up, is expected to improve the quantity of available nitrogen in the citrus fields.

A census of trees was made in Montserrat during January to determine the ecological relationships of certain scale insects which periodically—usually annually—develop in great numbers on citrus in this island. The principal climatic features which distinguish this from the citrus-growing islands to the south are a protracted dry season, a moderate rainfall, periods of relative humidity as low as 40 per cent. and a strong prevailing wind. The census showed that the incidence of *Coccus viridis* is positively correlated with moderate exposure to the wind, and negatively with (1) complete exposure to wind of high velocity, (2) shelter from wind—often combined with partial shade, and (3) an abnormal condition of the tree characterised by yellowish-green foliage. It is considered that the attacks are ultimately correlated with the metabolic condition of the cell-sap in the twigs and foliage of the host, and a series of experiments has been inaugurated to provide further information concerning this relationship.

Other pests noted included the following: in St. Lucia, *Litostylus pudens* attacking leaves of citrus, the Flatid *Ormenis pygmaea*, which, though parasitised by *Telenomus* spp., attained the status of a pest in a large outbreak early in the year, *Scapteriscus vicinus* on citrus nursery stock, vegetables and ornamentals, and an Eriophyid and a Tetranychid mite causing distortion of citrus foliage, principally on limes; in Dominica, *Othreis apta* Wlk., *Athysania* sp. and *Gymandrosoma* (probably *G. aurantianum* Costa Lima) attacking citrus fruit, *Orthezia insignis* in occasional abundance on individual branches of citrus, a species of snail eating the lower surfaces of citrus leaves, and a species of ant removing opening buds on topworked grapefruit; in Montserrat, *Orthezia praelonga*, which was found in great quantity on trees which were covered with the " black blight " fungus, and a bee cutting the leaves of lime.

In fulfilment of arrangements made by the Advisory Department for the introduction into St. Vincent of the Amazon fly, *Metagonistylum*

minense for use against the sugar-cane moth borer, *Diatraea saccharalis*, material was collected at Roseau and Cul de Sac Estates in St. Lucia, and shipments of adults and pupae were sent to St. Vincent on 23rd April and 23rd May by S.S. *Duc d' Aumale*.

The investigation into the extensive dying of seedling limes has been continued. The symptoms observed on trees which had part of their root systems exposed (including the ultimate rootlets) corresponded exactly with those noted on trees dying in the field. Mutilation of the cortex of certain roots, in imitation of severe insect attack, and eighty-two inoculations with various fungi failed to produce any of the symptoms associated with dying.

Death of the tree, in the majority of cases, takes place in the dry season, and is directly due to desiccation of the plant beyond the limit of recovery. The water loss is greatest in the dry season when wind action is often combined with low atmospheric humidity. The earliest symptom of impending decline is a general curling of the leaves, and a bending over of outermost twigs, giving the tree a wind-swept appearance. In the Lesser Antilles it has proved to be useless to take palliative measures at later stages than this, and it is not yet known what degree of effectiveness can be expected from therapeutic methods adopted immediately this symptom is noted. The only preventative methods which can be suggested are those likely to stabilize the water balance of the tree—application of water and the incorporation of humus into the soil. The provision of shade is of help, but is out of the question at short notice. It has been noted that the dying of trees growing in heavy soil and under shade in St. Lucia and Dominica is often protracted, and fields are known which have survived by more than ten years those growing in lighter soils in the same island. It remains to be shown how death of the fibrous roots on a large scale is brought about under field conditions, and experiments are in progress to determine how far such factors as low humidity and lack of soil moisture, and attack by Wither-tip disease affect the water balance of the tree.

Brevities.

The Acting Commissioner of Agriculture visited the Leeward Islands from 1st to 25th May and St. Lucia from 8th to 11th June.

* * *

The Principal, Prof. Harrison and Dr. Dodds with a party of students from the College visited St. Vincent from 12th to 18th April.

* * *

Dr. J. N. See has been appointed Veterinary Officer for the British Virgin Islands. He assumed duties on 20th February, 1939. Dr. See will be mainly engaged in an attempt to eradicate tuberculosis and ticks from cattle.

* * *

Introductions of the Amazon fly (*Metagonistylum minense*), a parasite on the Small Moth Borer of sugar cane, have recently been made from St. Lucia to St. Vincent with the object of controlling the cane borer in the latter Island.

* * *

The Acting Commissioner of Agriculture proceeded on four months' vacation leave on 12th June. During the absence of Mr. Skeete, Mr. D. D. Paterson, Reader in Agriculture, has undertaken the duties of Acting Commissioner of Agriculture.

* * *

The Principal of the Imperial College of Tropical Agriculture paid short visits to St. Kitts-Nevis and Antigua in April and attended the eighth meeting of the Advisory Committee of the British West Indies Central Sugar Cane Breeding Station in Barbados from 2nd to 4th May.

PROPAGATION OF THE MANGO.*

The Propagation of the Mango in Jaffna II.

The first part of this paper described a special method of budding the mango (*Ibidem*, pp. 86-91, H.A., 1937, 7: 756). The present article deals with the preparation of budding tape, potting rootstocks and the selection of budwood. Points of interest in potting are the severance *in situ* of the tap root of the budded plant a week before potting or transplanting and the use as pots of plain zinc sheets rolled into cylinder form 4 inches in diameter and held by dove-tailed joints strengthened at top and bottom by a girdle of coir string. A porous bottom to the pot is contrived by compacting a small quantity of red loam at the bottom of the pot. When transplanting, the pot and its contents are placed in the ground after loosening the string, the soil is filled in, and the loosened cylinder gently drawn out. The cost of each pot is 12 cents, but they are practically indestructible. Budded plants which have had their tap roots cut before transplanting bear earlier than those budded in the permanent positions. Dormant planting is advised, but, if a flush is in progress at the time, it should be pruned off. As far as information on stocks is available it seems that the sour types of *Mangifera indica* are the most suitable and plants on them require less attention as regards manuring and watering than those on the better varieties. *M. zeylandica* is less promising as a stock than was at first thought. Budwood should be selected from current season's growth showing a pale green colour and smooth surface, the flush being not less than a month old. The characters on which a parent tree should be selected are high and regular yield, good disease resistance, and large, small-stoned, well-flavoured and coloured fruits having firm pulp and a minimum of fibre.—(*Imp. Bur. of Hort. & Plantation Crops*, Vol. VIII, No. 1, Abs. 248, p. 70, 1938.)

* See also *Tropical Agriculture*, XV, No. 6.

PAPAW MOSAIC DISEASE.

By R. E. D. Baker,
(*Senior Lecturer in Mycology, Imperial College of Tropical Agriculture.*)

Introduction.

In Trinidad the papaw (*Carica papaya*) is grown as a fruit tree in gardens on a small scale but is not cultivated on a plantation scale either for the production of fruit or of papain. The trees grow well in good or fairly good soil and produce fruit abundantly throughout the year. In poor soil they do not thrive but produce small inferior fruit, and suffer severely from drought in the dry season. In all districts the trees are severely attacked by mosaic, a serious disease which has been known in the island for some years.

Papaw mosaic disease has been the subject of investigation at this institution from time to time for nearly ten years. In writing this article the unpublished work of L. N. H. Larter*, T. A. Russell*, G. C. Stevenson*, A. M. Gwynn and S. H. Crowdy, all of whom, in addition to the author*, have had considerable experience of this disease, has been drawn on freely.

Symptoms.

The symptoms of the disease in Trinidad are very variable. In a typical instance, water-soaked areas known as 'oil-spots' on the petioles (Fig. 1) and a marked mosaic on the leaf laminae (Fig. 2) appear almost simultaneously. Possibly the mosaic appears first in the majority of cases, but in several observed instances the 'oil-spots' appeared first, and the latter have been found to give a better indication of the disease in its early stages than the mosaic symptoms. In some instances no marked mosaic, but only a general chlorosis develops. The symptoms first appear on the petiole and lamina of a newly formed leaf, about the size of one's hand, and in three or four weeks the growing point is involved, after which no new leaves are produced (Figs. 3 and 4). Leaves which are full-grown when the disease first appears never develop mosaic or 'oil-spot' symptoms and are unaffected until the rapid die-back of the crown commences. Usually the crown of the tree dies eight or nine weeks after the symptoms first become visible and secondary rotting rapidly sets in (Fig. 5). This rotting is usually arrested from one to two feet below the original apex of the tree, and there is a profuse development of axillary buds (Fig. 6); those at the top of the stem are affected by the disease almost at once, but axillary branches lower down may grow to a considerable size and even bear fruit (Figs. 7 and 8). The disease is not always fatal to a vigorous tree, and the degree of recovery possible appears to depend to some extent on the initial vigour of the tree. Instances have, however, been observed where, on apparently vigorous trees, the course of the disease has run much more rapidly than usual, and the trees have been completely killed in four or five weeks without developing any lateral branches. Usually, when a vigorous tree has been cut back after an attack it will produce an abundant growth of axillary branches, which if judiciously thinned down to two or three, will bear fruit (Figs. 9 and 10).

This disease has been known in Trinidad for some years and is now very common. At a casual glance it appears to be more abundant now than it was six years ago. The chlorotic leaves and dead tops of trees which have been attacked are seen on all sides in the gardens, and so common is the disease becoming that it is now unusual in some areas to see an unattacked tree of any considerable size, *i.e.* more than three or four years of age (Fig. 11). It is remarkable that vigour in a tree is no protection against the disease—in fact there is evidence to the contrary—that really vigorous heavy-bearing trees are more readily attacked than weaker ones. Male, female and hermaphrodite trees are all attacked with equal readiness (*see* below). Natural recovery is possible, and very large trees which have been attacked more than once are sometimes seen (Figs. 7 and 8). These are characterised by the loss of their leading shoot and by their profuse development of axillary branches.

In other countries, allied or identical diseases have been described from time to time. Smith (9) describes a mosaic disease of the papaw in Jamaica which is almost certainly identical with the Trinidad disease. This disease produces a dwarfing and yellowing of the terminal leaves, while the lower leaves hang down and die. Finally the whole crown dies, and lateral buds start to develop, but soon die. In his reports Smith (10, 11) lays stress on the importance of the disease in Jamaica, and states that 'Mosaic is the limiting factor in the cultivation of papaws on a large scale in the Liguanea plain'. He also states that if the crop was ever cultivated on a large scale, the development of an immune variety, which he believes to exist, would be necessary.

What are apparently two distinct mosaic diseases of papaws are described from Santo Domingo under the one name of 'Curly Leaf'. Ciferri (2) describes a 'Curly Leaf' disease, resembling that from Jamaica which is almost certainly identical with that occurring in Trinidad and Jamaica. He describes the symptoms as a curling of the younger leaves to form 'cushions' while the older leaves take on a partial yellowish colouration, forming a mosaic of yellow and green spots. The leaves fall in one or two months, or dry up and do not fall, and the whole top dies in two months. Lateral shoots develop, but soon become diseased and die. Ciferri, however, does not consider this disease to be caused by a virus, but states that he found zoogloea in the latex of diseased trees and carried

* Dissertations for the Associateship, I.C.T.A., 1931, 1932 and 1933.

out successful inoculations, producing the disease in healthy trees by injecting this latex. A criticism of Ciferri's inoculation technique is that a virus present in the latex might also have been transmitted and might have been the real cause of the disease while the protozoa were harmless. Stevenson, although he could find no trace of protozoa in the latex, made repeated attempts to transmit the Trinidad mosaic disease in this manner without success. Judging by the symptoms, therefore, it is possible that the mosaic and die-back diseases of papaws in Trinidad, Jamaica and Santo Domingo are identical. Similar, but apparently less serious diseases of the papaw, presumed to be of virus origin, have been described from several countries. The writer has seen a disease of this type in Puerto Rico and is satisfied that it is distinct from the Trinidad mosaic disease*. It might, however, be caused by a less virulent or attenuated strain of the same virus. The symptoms of this disease, which is known as Bunchy Top, are as follows:—Abnormally yellow leaves are produced, and the petioles of young leaves, instead of being borne almost vertically, as in the case of healthy plants, extend almost horizontally, at right angles to the main-stem of the plant, both petioles and internodes being shortened. The lower leaves retain their green colour and show no symptoms of the disease. Flowers are dwarfed or distorted and drop prematurely, and few or no fruits are produced on diseased trees. It has been shown also that diseased trees contain less latex than healthy trees. Trees are finally reduced to tapering poles with a tuft of small leaves at the apex. This disease must not be confused with the failure of trees on a poor soil (Fig. 12) or even with trees which in their old age have reached an excessive height. Such trees cease to bear fruit, begin to taper and to produce progressively smaller leaves and finally die. In Bunchy Top disease axillary buds often proliferate lower down the trunk and produce healthy shoots, and, as with the Trinidad mosaic, the disease appears to spread slowly down the trunk and if a tree is beheaded in time it may be cured. The latter point is a striking resemblance between the two diseases, but they are dissimilar in that the rapid die-back, so characteristic of the Trinidad disease has not been observed in Puerto Rico, where the diseased plants linger on for many months. The disease has so far not been transmitted by artificial means and no insect vector has been found.

Ciferri describes a second 'Curly Leaf' disease from Santo Domingo which is almost certainly identical with the one in Puerto Rico, as the published descriptions of the symptoms of the two diseases correspond very closely.

Outside the West Indies diseases of this type have been described from Queensland, China, Burma and Java. A disease similar to that in Puerto Rico is described from Queensland by Morwood (6) and Simmonds (8) under the name of Yellow Crinkle. As in the Puerto Rican disease the young leaves are chlorotic and malformed and the old leaves fall, leaving a bare stem crowned by a few stunted leaves. Although the disease is seldom fatal and usually only causes a reduction in crop after a period of drought, it is thought to be caused by a virus. Ho and Li (5) report a disease from the Kwang-tung Province of China which they call Papaw Mosaic. It is characterised by a puckering, upward curling, stunting and yellow inter-veinal discolouration of the foliage, followed by desiccation and shedding. Badly diseased leaf blades are abnormally small with much shortened petioles, and the size of the fruit is also greatly reduced. Su (12) reports a similar disease from Burma which causes foliar crinkling and distortion, which is apparently of virus origin, and reduces the yield in severe cases. Lastly, Rant (7) in Java describes a disease of which the symptoms are similar in many respects to the Trinidad disease, but which is thought to be caused by a bacterium, *Bacillus papayae*, with which Rant claims to have reproduced the symptoms of the disease by inoculation.

It is evident therefore that in the West Indies and other countries there is a group of diseases of the papaw with reasonably similar symptoms but of greater or lesser severity, which, although definite proof is usually lacking, are thought to be caused by viruses, protozoa or bacteria. In the next section the possible causes of the Trinidad mosaic disease will be examined in greater detail.

Possible Causes of the Disease.

In Java, Rant (7) found bacteria, and in Santo Domingo Ciferri (2) found protozoa associated with a disease of this type. Elsewhere papaw mosaics, leaf crinkles, and curly leaf diseases have been assumed to be caused by viruses, although no definite proof has ever been offered. This is the position in Trinidad. In a detailed series of investigations Larter and Russell were unable to find fungi or bacteria in the tissues of diseased trees, and Stevenson was also unable to find either bacteria or protozoa in the latex. It is practically certain, therefore, that the disease is not caused by any of these agents.

It has several times been suggested in Trinidad that papaw mosaic is a deficiency disease brought about by soil abnormalities. Those who have studied the disease at this institution are, however, of the opinion that this theory, although attractive at first sight, cannot be true. The evidence against such a theory is formidable. Firstly the scattered distribution of the disease both in the island and also in an experimental plantation, which was laid down at this institution for the study of the disease, does not favour such an explanation. Secondly the progress of the disease through the papaw tree is not such as would be expected with that type of disease. Plants affected with deficiency diseases are usually weak and have a poor appearance, and may linger on for some time becoming progressively weaker

*I am indebted to Dr. Kevorkian of the Mayaguez Experiment Station for demonstrating this disease to me.

PAPAW MOSAIC DISEASE.

FIG. 1.—Close-up of the growing point of an infected male tree. Note the prominent 'oil-spotting' on both stem and petioles. Photo by A. K. Briant.

FIG. 2.—Full-grown leaf with typical mosaic symptoms. Photo by A. K. Briant.

Figures 3 to 12 show the development and control of the disease.

FIG. 3.—The disease in an early stage: leaves curled and growing point affected.

FIG. 4.—A slightly more advanced stage than that depicted in Fig. 3. When a tree has reached this stage, no more new leaves will be produced and die-back will shortly commence.

FIG. 5.—Die-back has now commenced and all the leaves except one have been shed.

FIG. 6.—Die-back has been arrested a foot or two below the original apex of the tree and there has been a profuse develop-

FIG. 7.—The lateral branches have developed and are bearing fruit, and natural recovery is complete.

FIG. 8.—Here natural recovery has failed. The disease has spread down the trunk and three of the lateral branches have been infected.

FIG. 9.—Control by topping. The tree has been cut about four feet above ground level and three lateral branches have been allowed to develop.

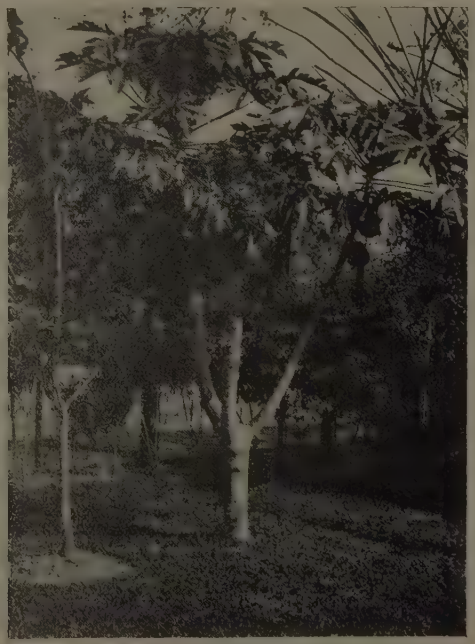


FIG. 10.—Control by topping: a later stage. Three lateral branches have developed and borne fruit. The one nearest the camera developed the disease a second time and has been topped again.

FIG. 11.—A group of diseased trees.

FIG. 12.—The tree in the foreground shows 'little-leaf' symptoms. The one on the right is healthy, while the tree in the left background has mosaic disease.

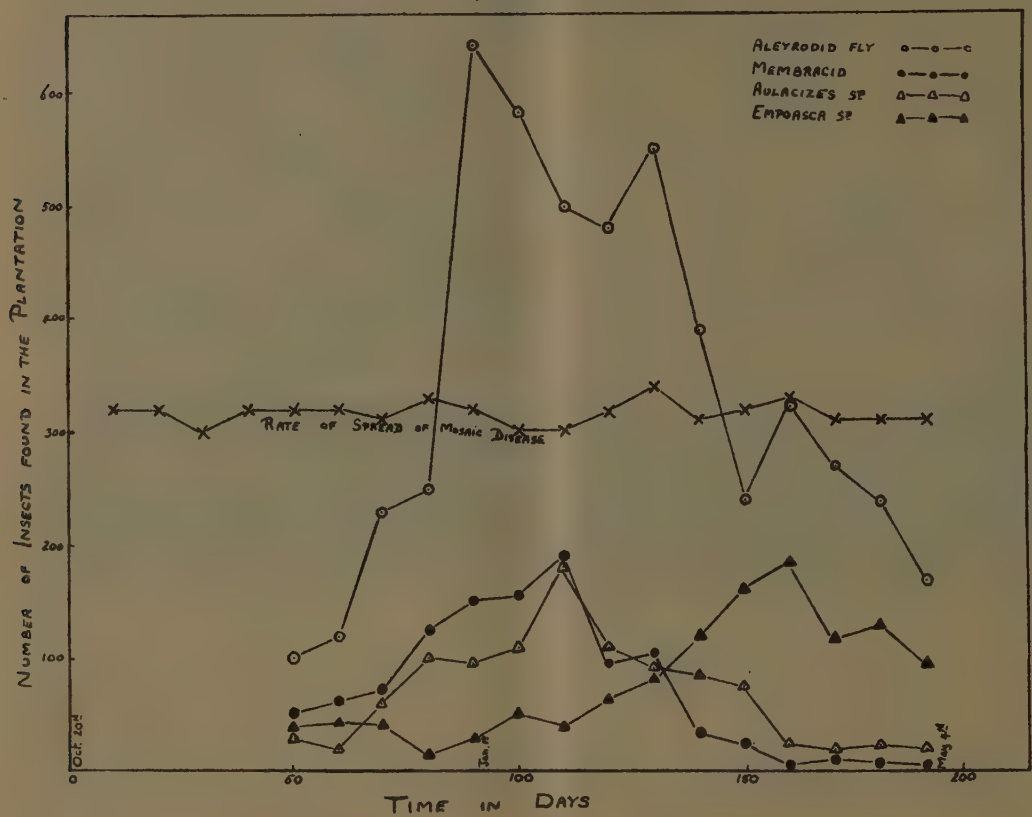
FIG. 13.—(Right) Plants on which large numbers of Empoasca sp. have fed. Healthy plants (left).

before they die. This is in strong contrast to the rapid destruction of apparently vigorous trees attacked by the papaw mosaic disease. Moreover, plants or trees suffering from a deficiency disease seldom recover naturally, nor are they improved by cutting back. This is again in strong contrast to the papaw mosaic disease which exhibits a considerable tendency towards natural recovery and can be controlled by cutting back. Figures 7, 9 and 10 show trees which have made natural recoveries or have been saved by this method. A discouraging feature of the disease is that it often attacks the best trees which are usually carrying a large crop of fruit. This feature of the disease led to a suggestion that the explanation of the disease might be purely physiological and that the crown of the tree died because it was carrying a too heavy crop of fruit at the top of a long trunk. This explanation is unsatisfactory because if it was true such trees would surely shed their fruit or cease to bear before they died back in this way, and in any case male trees which bear no fruit are frequently attacked. Observations made in the plantation at this institution indicate that male and female trees are attacked in approximately equal numbers. Instances are known where trees have even been attacked before they have flowered, a fact which also disproves the theory that insects visiting the flowers might be the vectors of a virus disease. We are therefore forced to the conclusion that this disease is probably caused by a virus carried by an insect feeding on the foliage, but even the evidence on this point is conflicting. The distribution and some of the symptoms of the disease support this theory. Its haphazard occurrence is typically that of a virus spread by an insect flying at random from tree to tree. The mosaic, the reduction in size and the distortion of the leaves, and the production of insipid fruit are typical symptoms of a virus disease, but the rapid die-back associated with these symptoms is not typical of this type of disease. Although virus diseases which destroy their host-plants are known, the majority do not do so, but rather tend to weaken the plants and reduce them in size or in yield. A more serious objection is that recovery from the disease is possible. All virus diseases are systemic, that is to say, all parts of an affected plant (usually with the exception of the seeds) contain the virus. Therefore if papaw mosaic is a virus disease neither natural recovery, nor the production of healthy side shoots, nor the control of the disease by topping, all three of which are known facts, should be possible. This is a serious objection to the theory, but may possibly be explained as follows. Virus diseases are known to spread but slowly through plant tissues and it is possible that in a tree such as the papaw the die-back of the crown might be more rapid than the downwards spread of the virus so that the latter might in some instances be prevented from entering the lower parts of the tree. Similarly, a tree cut back while still in the early stages of the disease would have a very good chance of making a complete recovery, as the virus might not have had time to have spread to the lower parts of the tree. Another objection to the theory is that all attempts at proving the virus nature of the disease by direct sap inoculation or by grafting have failed, although the latter had a hardly fair trial as diseased tissues cannot be induced to 'take' on healthy tissues. Grafts made by inserting pieces of diseased tissue into the growing points of healthy trees met with no better success. Much time was devoted to a search for the insect vector, again without success. In spite of these objections and failures, the theory that the disease is caused by a virus still appears to be the only tenable one. It must, however, be one of the group of virus diseases which are transmitted by insects only and never by sap-inoculation. The identity of the vector of a disease of this type is often very difficult to establish.

Work with Insects.

With this idea in mind the author some years ago made a detailed study of the insects associated with the trees in the papaw plantation at this institution. Gwynn, Stevenson, Larter and Russell also studied the insects but failed to transmit the disease with any of them. Collections were made of all sucking insects feeding on or associated with the trees, and records were kept of their relative abundance through the year. Although most of the species of insects showed a 'peak' in numbers at some time in the year, the rate of spread of the disease was constant throughout. The 'peaks' in numbers of insects present occurred in the dry season when conditions are probably more favourable for their rapid increase (Fig. 14). Jassids of ten genera occurred, of which two, *Aulacizes* sp. and *Empoasca* sp. were common. Two Fulgorids were observed, one fairly commonly, and a Membracid occurred in large numbers. As the Fulgorid was hardly sufficiently abundant and no Membracids have been described as vectors of virus diseases, they were considered as of less importance than the Jassids. Far the commonest insects in the plantations were Aleyrodid white flies, and although this insect is a very poor flier it was thought to have been present in sufficient numbers to transmit the disease. Repeated infection experiments were carried out with the two Jassids and the Aleyrodid fly without success, but in spite of these failures the latter is still considered to be a possible vector. Its small size renders it exceedingly difficult to handle and the infection experiments with it cannot be said to have been conclusively negative. No difficulty was experienced in handling *Aulacizes* sp. and *Empoasca* sp. and there can be little doubt that neither species is the vector of the disease. An interesting result was obtained when large numbers of *Empoasca* Jassids were allowed to feed on young papaw plants (Fig. 13). Symptoms reminiscent of those described by other authors as 'Curly Leaf' were produced, but the conclusion was reached that the symptoms constituted a

FIG. 14.



'stigmonose' effect caused by the large numbers of insects feeding on the plants. Therefore, although the Aleyrodid fly is suspected of being the vector there is still no definite proof that this is so.

Control.

The papaw is a valuable and useful fruit tree, and if it were not for this disease, it could be much more widely grown. At present the available evidence indicates that whenever more than a few trees have been planted together, the disease has become very severe and has quickly destroyed them. Five instances of this nature are known to the author, two of which were the first and second plantings of the experimental plot of two acres at this institution. No attempt was made to control the disease in the experimental plot as diseased material was required for other purposes, and both plantings were rapidly destroyed by the disease. However, although the cause of the disease and its method of spread are unknown, there is no reason why its control should not be attempted. The disease is easy to recognise in its early stages and the method of cutting back appears to give promise of success. Trees should be cut back at least three or four feet or more, depending on the height of the tree, behind the growing point, and two or three healthy shoots should be allowed to develop. As the tree is hollow, the cut surface should be covered with an inverted jam-tin or some such receptacle, or filled with concrete to prevent the breeding of mosquitoes and the eventual rotting of the tree. Trees treated in this way (Figs. 9 and 10) have completely recovered and have since borne fruit. There is reason to believe that it would also be beneficial to cut back old trees which have become too tall and have ceased to produce marketable fruit. Although this method of control is successful on a small scale it has yet to be tested on a large scale where its success would turn on whether the intensity of the disease could be reduced by this policy of the destruction of diseased material as soon as it appeared both in the plantation and in the surrounding gardens. Concerted action will be necessary because if infected insects can travel for some distance, no individual can hope to control the disease without the help of his neighbours. A few diseased trees will probably serve as a reservoir of infection for a large area. It is possible, of course, that if the

disease has an unknown alternate host plant serving as a reservoir of infection, no benefit at all will be noticed. It must be emphasised however, that even now by this method, without the co-operation of his neighbours any gardener with a few trees only can preserve his supply of papaws without replanting. The author has three trees in his garden which have been attacked five times during the last three years but all three are still alive and bearing fruit. Smith states that this method has met with some success in Jamaica also. He is of the opinion that varieties of papaw resistant to the disease occur in Jamaica, but there is no evidence for their existence in Trinidad. If this method of direct control does not succeed probably the only hope of controlling the disease lies in the discovery or introduction of a resistant variety of papaw.

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SPONTANEOUS COAGULATION OF RUBBER LATEX.

As early as 1913, Whitby advanced the view that spontaneous coagulation in rubber latex takes place before decomposition processes begin and understood coagulation to be an enzyme change comparable with blood clotting. On the other hand many latex chemists are of the opinion that the spontaneous coagulation of latex is due to the formation of acid from the bacterial decomposition of serum constituents. Although, in opposition to this latter theory, it has been demonstrated that coagulation frequently takes place before there is any appreciable change in the pH, the matter of latex coagulation is still treated as open to question.

Two reasons why this doubt has arisen are advanced by Paton*. In the first place many samples of latex have only a slow rate of coagulation and remain liquid for a period of time sufficient for the development of vigorous bacterial fermentation. In such circumstances the latex is much decomposed and it may well be that the coagulation by the acid product of fermentation anticipates coagulation by enzymes.

Latex from young trees however frequently coagulates as soon as it emerges from the tree and comes in contact with the freshly cut tissues of the bark. Paton considers that the bark tissues play some rôle in the coagulation either by neutralisation of some anticoagulase or by direct promotion of coagulation. Observation showed that the coagulation was independent of pH, taking place even in slightly alkaline conditions and that the soluble substances of rubber bark acted as accelerators and increased the velocity of coagulation. The spontaneous coagulation which takes place on rainy days even with mature trees is attributed to the greater solubility of the bark substances in latex due to softening of the bark tissues by rain water. Among the substances isolated from a cold water extract of the bark were calcium, manganese, and soluble tannin substances. All these substances assist the spontaneous coagulation of latex.

The second reason why the cause of coagulation remains so long in doubt was the difficulty of finding a bactericide which in concentration insufficient to coagulate latex would entirely prevent the growth of bacteria. A very effective bactericide in sodium pentachlorphenate has recently been examined and found to be a very effective preservative provided the pH is kept above the limit for enzyme action. The use of this substance has enabled further research on the coagulation of latex to be carried out.

NOTE.—Additional support for Whitby's theory is furnished by Stamberger (*Nature*, Vol. CXLIII, No. 3621, p. 520). He found that the conductivity of latex did not change until coagulation was complete and that the pH after coagulation was only .2 lower than the average original figure of 6.4. Further support was provided when strong antiseptics preventing bacterial decomposition were added to fresh latex without preventing spontaneous coagulation. As an example, the addition of .3 and .4 per cent. sodium pentachlorphenate had no influence on the behaviour of latex with respect to its coagulation. No decomposition nor any change in the pH value of 7 could be found in coagulated samples which were measured over a period of 3 to 6 weeks.

H. F. B.

* F. J. Paton, *Chemistry & Industry*, Vol. LVIII, No. 11, p. 246.

PROVISIONAL LIST OF THE DATE PALMS OF THE 'IRAQ.

By V. H. W. Dowson, M.A., Dip. Agric. (Cantab.), F.R.E.S.

Introductory.

This list is probably incomplete, especially in those varieties which are found only in the north of the 'Iraq because the author has had less opportunity of studying these varieties than those found in the south. Despite its incompleteness, however, this list is being published now, because it seems desirable that an attempt be made to standardize the spelling of date varietal names.

In general, the cultivators, who know the names of date varieties do not know how to write, while people who know how to write do not know the names of date varieties. The result is that there is much confusion in the spelling of date varietal names.

Confusion is increased in the process of transliteration from Arabic script to English. Not only is it difficult for English-speaking peoples to appreciate the phonetic values of unfamiliar sounds, but English does not possess symbols to represent all the sounds used in Arabic. For example, the Arabic consonant "ghain" has no equivalent in English.

In the following list, an attempt has been made to select the spelling which of all is in most accordance with grammar and sense, even though it does not correspond exactly with that of local pronunciation. Thus Badhinjani has been preferred to Baydhinjani, which is nearer the speech of the people. On the other hand, in the large number of cases where the correct spelling is doubtful, pronunciation has been the chief guide in the selection of spelling. It is to be noted that the corruption of Ustadh to Usta is so general that it seemed pedantic to preserve the original word. Ustadh 'Imran, therefore, is shown in the list as Usta 'Imran.

Simplified Spelling.

It was realised that a spelling assisted by diacritical marks had little likelihood of being adopted by those two groups of persons who use the names of dates in English script, namely British and American traders and American date planters. A simplified spelling has consequently been used for the names of the dates listed, which represents the original as far as is possible without the use of these marks.

Synonyms.

Most of the synonyms listed are preceded by a query. This means that it is presumed, generally from etymological evidence only, that the standard spelling and the synonyms both represent the same date variety. Thus, Adhafir al-Ghazal (Gazelle's hooves) and Dhilf al-Anzah (Goat's hoof) are presumed from the similarity of meaning to be two names of the same variety, although the writer has seen palms of neither and dates only of the former. It is therefore, possible that what have been called synonyms in this list may later be found to be names of separate varieties. Conversely, it may be found that some of the names, which have been given varietal rank, are really synonyms.

Meaning.

An attempt has been made to state the meanings of the names, not so much because the meanings give any very accurate description of palms or dates, but because they often help to fix the spelling. This help has been accepted with caution; and the temptation to twist the spelling to fit a fancied derivation has, it is hoped, been resisted.

Status.

Varieties have been put into four categories, numbered 1 to 4. 1 indicates very common varieties, such as Usta 'Imran and Zahdi, 2 rather less common varieties such as Qintar and Fursi, while 3 indicates the rare varieties, such as Hajri or Shirani. Names which need confirmation before they can be admitted to varietal rank, and those of seedlings, which are not yet, and perhaps never will be, numerous enough, or striking enough, to be considered distinct varieties have been included in 4.

Authority.

Where no authority is shown, the present writer accepts the responsibility of reporting the presence of the variety. Other authorities are represented by letters, as follows:—

A. —'Abbud Eff. 'Ali ash-Shubbar.
Ab.—'Abd al-Jabbar Eff. al-Bakr.
C. —Major S. G. Cameron, M.C.
Cl. —Surgeon Major W. H. Colvill.
D. —Mr. A. Dutt.
F. —Hajji Sulayman Faydi.
G. —Lt. C. Gautby.
Gh.—Georgis ? Beg. Ghanima.
N. —Mr. Roy W. Nixon.
P. —Dr. Paul B. Popenoe, Ph.D.
S. —Shaykh 'Abd al-Wahid al-Bash Ay'an al-'Abbasi.

Corrections.

The author's aim has been to list all 'Iraqi date varieties and to spell their names correctly both in English and Arabic. He would welcome additions and corrections.

PROVISIONAL LIST.

Date Palms of the 'Iraq.

No.	Name.	Synonyms.	Meaning.	Status	Authority
1	Abadli	—	? (Contraction of 'Abid 'Ali)	3	—
		? 'Abdali		—	S.
		? Daqal			
		? 'Abid 'Ali			
2	Abu Suwayd	....	Father of little black	3	—
		?Umm as-Sud		—	C.
		? Bint as-Saudah		—	S.
3	Afandi	Effendi	Mister	4	A.
4	Ahmad Shili	—	(Man's name)	4	N.
5	Ahmar Dubas	—	Red date syrup	4	N.
6	Akhtari	—	?	4	D.
7	Akhu Khastawi	—	Brother of Khastawi	4	—
8	Aksharhi	—	?	4	S.
9	Ali Musa	—	(Man's name)	4	—
10	Aliqah	—	? Pollinated	4	—
11	Aal Launah	—	Of good colour	4	N.
12	Aluchiyyah	—	Like a bullace	3	—
13	Amir Ali	—	Prince 'Ali	3	—
14	Amir Hajj	—	Pilgrimage leader	2	—
15	Aubari	—	of ambergris	4	Ab.
16	Anmar	—	? Spotted	2	N.
17	Aqili	—	?	4	—
18	Arab Siki	—	Arab's yard	3	G. & N.
19	Araq Asiya	—	Asiya's sweat	4	C.
20	Armuti	—	Pear-like	4	A.
21	Asabi al-Arus	? Daqal 'Arus	The bride's fingers	2	—
		? Kilk 'Arus			
22	Asafi	—	?	4	S.
23	Asaliyyah	—	Honied	4	C.
24	Asfar Uddah	—	? Yellow of saddle	4	S.
25	Ashqar	—	Roan	2	—
26	Ashrai	—	?Pointed	4	—
27	Ashrasi	—	? Hard	1	—
28	Ashrasi Aswad	—	Black Ashrasi	4	P.
29	Ashuri	—	Of a tenth	4	P.
30	Ashwit	—	?	4	—
31	Auniyyah	—	? Tall	4	C.
32	Aurah	—	Woman	4	—
33	Awashah	—	Of 'Aishah	4	Cl. & P.
34	Ayn Ullah	—	God's eye	4	—
35	Asraq	? Zariqah	Blue	2	—
		? Azraqani			N.
		? Daqal Azraqi		—	C.
		? Azraq al-Azariq		—	S.
36	Badami	—	Almond-like	2	N.
		? Daqal Badam		—	Cl.
		? Daqual Badami			
37	Badhinjani	—	Egg-Plant-like	2	—
38	Badrayah	—	Of Badrah	1	—
39	Bahrab	—	?	2	—
40	Balah Ban	—	Ben-tree dates	4	P.
41	Balluti	—	Acorn-like	3	N.
		? Daqal Balluti			C.
42	Banafshah	—	? Violet-colored	3	—

PROVISIONAL LIST.—(*Contd.*)

Date Palms of the 'Iraq.

No.	Name.	Synonyms.	Meaning.	Status.	Authority.
43	Banat al-Bidh	—	White daughters	3	—
44	Banat al-Jiddah	—	Daughters of the midwife	2	—
45	Banat Aufi	?Kham 'Aufi	Daughters of 'Aufi	3	—
46	Bandar	—	(Man's name)	4	D.
47	Bani Rabah	—	Sons of Rabah	4	—
48	Baqlah	—	? Broad bean	4	—
49	Barban	—	? Purslane	2	—
50	Bar Maliki	—	? God's desert	2	N.
51	Barni	—	?	3	—
52	Barraqi	—	Bright	3	D. & C.
		? Barrakah			N.
53	Basrawi	—	Of Basrah	2	—
54	Baththi	—	? Loose	4	S.
55	Battikhi	—	Melon-like	4	S.
56	Baydh al-Bulbul	—	Bulbul's eggs	4	—
57	,, al-Hamam	—	Dove's eggs	2	
58	Baydawi	—	? Of the desert	4	N.
59	Bayraqdar	—	Standard bearer	3	N. & A.
60	Bint ad-Dahmam	—	The daughter of the black mare	4	S.
61	Bint al-Arab	—	The daughter of the Arabs	4	S.
62	Bint al-Bahr	—	The daughter of the sea	4	S.
63	Bint al-Basha	—	The daughter of the pasha	4	S.
64	Bint al-Jabal	—	The daughter of the mountain	4	—
65	Bint Ash-Shayk	—	The daughter of the shaykh	3	—
66	Bint as-Saba	—	The daughter of the lion	2	—
67	Bint as-Safra	? Safrawiyyah	Yellow girl	3	—
68	Bint Mushaymish	—	Daughter of a little apricot	4	S.
		?Umm al-Mishmish			S.
69	Birhi	—	?	1	—
70	Bubaki	—	?	2	—
71	Buraym	—	?	1	—
72	Chupan	—	? Shepherd	2	—
73	Dahiqat	—	? Yellow date	4	N.
74	Dam al-Faras	—	The blood of the mare	4	S.
75	Daqal Abbas	—	Date of 'Abbas	2	—
76	Daqal Amr	—	Date of 'Amr	3	S.
77	Daqal Badrah	—	Date of Badrah	3	—
78	Daqal Baghdadi	—	Date of Baghdad	4	S.
79	Daqal bin Ammar	—	Date of bin 'Ammar	4	S.
80	Daqal Birhi	—	Date like Birhi	4	S.
81	Daqal Biri Guzan	—	?	4	C.
82	Daqal Furayhah	—	Date of joy	4	—
83	Daqal Hamad	? Daqal Ibn Hamad	Date of thanks	4	S.
84	Daqal Hasuni	—	Date of Hasuni	4	—
85	Daqal Hisar	—	?Date of a date drying floor	4	N.
86	Daqal Imad	—	Date of a column	3	P. & N.

PROVISIONAL LIST.—(*Contd.*)

Date Palms of the 'Iraq.

No.	Name.	Synonyms.	Meaning.	Status.	Authority.
87	Daqal Imam Husayn	—	Date of Imam Husayn	4	N.
88	Daqal Ismail Qadri	—	Date of Isma'il Qadri	4	N.
89	Daqal Jumah	? Jumay'i	Date of Jum'ah	2	—
90	Daqal Khan	—	Date of a lord	4	N.
91	Daqal Kharuf	—	Date of a ram	4	C.
92	Daqal Mansur	—	Date of Mansur	3	—
93	Daqal Musa	? Baljani	Date of Musa	2	—
94	Daqal Qadhi	?Umm al-Qadi ?'Imamat al Qadi	Date of a judge	3	C. N.
95	Daqal Rajab	—	?Date of a prop	4	S.
96	Daqal Sag	—	Date of a dog	4	C.
97	Daqal Sayyid Ahmad	—	Date of Sayyid Ahmad	4	N.
98	Daqal Shabib	—	Date of Shabib	4	S.
99	Daqal Shannur	—	Date of ?	4	S.
100	Daqal Shatr	—	Date of ?	4	D.
101	Daqal Shatt	—	Date of a river	4	S.
102	Daqal Taha	—	Date of Taha	4	N.
103	Daqal Umar	—	Date of 'Umar	3	—
104	Daqal Yahudi	—	Date of a Jew	4	N.
105	Daqal Zahdi	—	Zahdi-like date	3	—
106	Daqlat an-Nur	—	Date of the light	3	—
		?Daqal Tannur			F.
107	Daqlat as-Sawi	—	?Dried up date	2	—
108	Daqlat Halimah	—	? Date of a fat camel	4	D.
109	Dayram al-Layl	—	? Rover by night	3	S.
		?Dayrumah			D.
		? Duraym			D.
		?Umm ad-Dayram			
110	Dayri	Tayyib al-Ism Mu'ayshi	? of Dayr	1	—
111	Dhilf al-Ghazal	?Dhifr al-Ghazal ?Adhafir al-Ghazal	Gazelle's hoof	3	—
		?Dhilf al-'Anzah			S.
112	Dirau	—	?	2	—
113	Duayli	—	?	2	—
114	Dubayni	—	?	2	—
115	Dukwayni	—	?Of the little black one	2	—
		? Dukhayni			S.
116	Duwayk	—	The little cock	2	—
117	Duwayriq	—	The little one of Dauraq	3	—
118	Falah	—	Husbandman	4	—
119	Farkh Abyadh	—	White shoot	4	—
120	Funduqiyyah	—	Hazel-nut-like	4	Cl.
121	Fursi	—	? Of Furs	2	—
122	Fursi Abyadh	—	White Fursi	3	D.
123	Gharibah	—	Extraordinary	4	C.
124	Ghurrah	—	Blaze	4	S.
125	Gulbay Harmaghi	—	?	4	A.
126	Gul Husayni	—	? Flower of Husayn	4	P.
127	Hababah	—	?	4	—
128	Habisi	—	Imprisoned	3	—
129	Habrah	?Hubr al-Jamus	Large boneless piece of meat	3	—
130	Hadal	—	Pendant	2	—
131	Hadhiri	—	? Ready	4	D.
132	Hajji Ahmad	—	Pilgrim Ahmad	3	—

PROVISIONAL LIST.—(*Contd.*)

Date Palms of the 'Iraq.

No.	Name.	Synonyms.	Meaning.	Status.	Authority.
133	Hajri	—	Of Bahrayn ?	3	—
134	Hallani	—	? Of a date basket	4	S.
135	Hallawi	—	Sweet	1	—
136	Hallawi Abu Buqay	? Buqay'i	Black and white Hallawi	2	—
					D.
137	Hallawi Aswad	Hallawi Ahmar	Black Hallawi	3	—
138	Hamar ar-Rad	—	? Redness of the thunder	3	—
139	Hambuzi	—	? Melon-like	4	S.
140	Hamrawi	—	Red	2	—
141	Hanushiyyah	—	Of Hanush	4	P.
142	Hairan	—	?	4	N.
143	Haruni	—	Of Harun	4	S.
144	Hasan Afandi	Hasan Effendi	Mr. Hasan	4	P.
145	Hasawi	—	Of Hasa	2	—
146	Hatimi	—	Of Hatim	3	—
147	Hatri	—	?	3	—
148	Hijazi	—	Of the Hijaz	4	S.
149	Hilai	—	?	3	—
150	Hilali	—	Of the new moon	3	—
151	Hulqumi	—	Of Turkish delight	4	N.
152	Hulwah	? Daqal Hulwah	Sweet	3	—
					Cl.
153	Hulwani	? Hulwan ash-Shaykh	? Of a dowry	3	—
154	Hulwat al-Jabal	? Jabaliyyah	Sweetness of the mountain	2	—
155	Hulwat al-Jauf	—	Sweetness of al-Jauf	4	—
156	Humrat Abd as-Sayyid	—	The red color of 'Abd as-Sayyid	4	—
157	Humrat al-Jabal	—	? The red color of the mountain	4	N.
158	Humrat Umm ad-Dimagh	—	The redness of the meninges	4	Ab.
159	Huwaysi	—	? Black	2	—
160	Ibadah	—	? Piety	4	—
161	Ibrahimi	Farakh Aswad	Of Ibrahim	1	—
162	Ifritah	—	Witch	4	—
163	Imran	—	(Man's name)	4	—
164	Injasi	—	Plum-like	2	—
165	Irani	—	Persian	4	S.
166	Ishaq	—	(Man's name)	2	—
167	Ismail Qadri	—	(Man's name)	4	—
168	Itri	—	? Fragrant	3	—
169	Izz ad-Din	—	Nobility of the faith	4	S. &D.
170	Jafari	—	Of Ja'far	2	—
171	Jaharah	?Umm Jaharah	? Comeliness	4	—
					C.
172	Jamal ad-Din	—	The beauty of the faith	4	N.
173	Jaumaki	—	?	4	N.
174	Jauzi (Baghdad Variety)	Jauzi Ahmar	Walnut-like	2	—
175	Jauzi (Basrah [different] Variety)	—			
176	Jauzi Abyadh	? Jauzi Asfar	White Jauzi	3	—
177	Jufayli	—	? Leafy	4	—
178	Kabir	—	Big	4	N.

PROVISIONAL LIST.—(*Contd.*)

Date Palms of the 'Iraq.

No.	Name.	Synonyms.	Meaning.	Status.	Authority.
179	Kabkab	? Bughbugh ? Kabkab al-'Ajam	?	1	—
180	Kadiyah	—	? Unproductive	4	N.
181	Kaka Wali	? Kakawani	?Brother of Wali	4	—
182	Karami	—	? Productive	4	D.
183	(Baghdad Variety) Khadhrawi	—	Green	1	—
184	Khadrawi (Basrah [different] variety)	—	Green	1	—
185	Khadhrawi Mandali	Khadrawi Baghdad	Mandali Khadrawi	1	—
186	Khalidi	—	Of Khalid	4	D.
187	Kharkani	? Qarqani	?	3	—
188	Khasawi al-Baghl	? Bayd al-Baghl	The mule's stones	3	—
189	Khasawi Mishri	—	? Mishri's stones	4	—
190	Khastawi	—	Having a stone	1	—
191	Khatibi	—	? Of a preacher	4	—
192	Khatriyyah	—	?	4	S.
193	Khatuni	—	Of a lady	4	P.
		? Daqal Khatun		—	Cl. &
194	Khirfaysh	—	? Rubbish	4	N.
195	Khisab	—	Fruit-bearing palm	2	—
196	Khiyarah	? Umm al-Khiyar	Cucumber	3	—
197	Khudhr al-'Abid	—	The blackish colors of the slaves	3	—
198	Khudhri	—	? Green (or) black	3	—
199	Khulas	—	Choice	3	—
		? Khulas Hasawi		—	S.
200	Khulas az-Zayn	—	Khulas of Zayn	4	S.
201	Khunayzi	—	? Stinking	3	—
202	Khuntariyyah	—	?	4	D.
203	Kisamishi	—	Raisin-like	4	N.
204	Kulawiyyah	—	Kidney-like	4	C.
205	Laami	—	? Feathered	4	D.
206	Lai Katunah	—	?	3	—
207	Liaydi	—	?	4	G.
208	Lului	—	Pearly	2	—
209	Lului Ahmar	—	Red Lului	4	F.
210	Madani	—	Of Madinah	3	—
211	Mahmudah	—	Scammony	3	—
212	Majmudah	—	? Frozen	4	—
213	Makkawi	? Daqal Makkawi	Of Makkah	2	—
		? Hallawi Makkawi		—	P.
		? Makkawi Ahmar		—	Cl.
214	Makkawi Asfar	—	Yellow Makkawi	3	C.
		? Makkawi Ashqar		—	Cl.
215	Maktum	—	Kept ?	2	—
216	Maktum Ahmar	—	Red Maktum	4	D.
217	Mal Allah	—	God's	3	—
218	Malquti	—	? Graded	4	P.
219	Marshadawi	—	?	4	D.
220	Marzuban	—	? Governor	3	—
221	Masrahi	—	Of the meadow	3	—
		? Matraki		—	N.

PROVISIONAL LIST.—(*Contd.*)

Date Palms of the 'Iraq.

No.	Name.	Synonyms.	Meaning.	Status.	Authority.
222	Mauzar	? Daqal Mauzar	Cartridge of Mauzer rifle	4	—
223	Mayah	—	Storax	3	—
224	Mayubat ad-Din	—	? Faults disapproved of by religion	4	—
225	Mayyaz	? Daqal Mayyasi	? Distinguished	3	—
226	Midad	—	? Bushels	3	—
227	Minaz	—	?	4	P.
228	Muaydini	—	? Of the little excellent one	4	S.
229	Mubarak	—	Blessed	4	—
230	Mubashbish	—	? Welcomed	3	—
231	Mudawi	—	? Nurse	4	D.
232	Mulabbas al-Ajuz	—	? Sweets of the old woman	3	—
233	Mulaffaf	—	Wrapped	4	P.
234	Mumaqq al-Hamra	—	The red pollinated one	4	—
235	Mumnayah	—	(A drug)	4	S.
236	Munayi	—	?	4	—
237	Muqattib	—	? Wrinkled	4	—
238	Muqnahah	—	? Bent	4	—
239	Musaydafi	—	? Like mother of pearl	3	—
240	Muwajjah	—	Crooked	4	P.
241	Nabati	—	Sugar candy	3	—
242	Najdiyyah	—	Of Najd	3	—
243	Naqibi	—	? Big	4	—
244	Naqsh al-Mibrad	—	File Marks	3	—
245	Nartah	—	?	4	D.
246	Nashi	—	? Quickened	4	S.
247	Nirsi	? Nirsiyan	?	3	—
248	Qalam Barmaki	—	Pen of the Barmicides	3	—
		? Asabi' al-'Arus		—	N.
249	Qandaqawi	—	? Of a gunstock	3	—
250	Qarah Ashrasi	—	Black Ashrasi	4	N.
		? Ashrasi Aswad		—	P.
251	Qaranfuli	—		4	N.
252	Qartali	—	? Of a basket	4	S.
253	Qasb	—	Tough date	2	—
254	Qaytas	—	? Whale	3	—
255	Qiblanah	—	? Of the Qiblah	4	N.
256	Qintar	—	(Weight of 100 lb.)	2	—
257	Qiyani	—	? Of slaves	4	—
258	Qudayri	? Jidrawi	? Of a small cooking pot	4	D.
259	Qurrat Ashrasi	—	? Refreshment of Ashrasi	4	P.
260	Raym	? Rimah	? Excess	3	—
261	Raywi	—	? Watered	4	N.
262	Rihawi	—	Fragrant	4	P.
263	Riq al-Banat	—	Girls' spittle	4	D.
264	Rumaythi	—	? Of Rumaythah	4	N.
265	Ruzayz	—	? Little rice	3	—
266	Saadah	—	Joy	2	—
		? Sa'adah Aswad		—	P.
		? Sa'idi		—	D.
267	Sabah Dhira	? Umm al-Tuwal	Seven to an ell	3	—
268	Sakizi	—	Of eight	4	—
269	Sanini	—	? Of the bare soil	4	S.
270	Saquti	—	? Letting fall its leaves	4	N.
271	Sarkhushi	—	Drunk	4	N.
272	Sayhani	—	?	3	—

PROVISIONAL LIST.—(*Contd.*)

Date Palms of the 'Iraq.

No.	Name.	Synonyms.	Meaning.	Status	Authority.
273	Saylani	—	? Of date syrup	2	—
274	Saysandali	—	?	3	—
275	Sayyid Baqir	—	Lord Baqir	4	N.
276	Sayyid Ibrahim	—	Lord Ibrahim	4	P.
277	Shahal	—	? Dark blue	3	—
278	Shalabi	Chalabi ?'Ali Shalabi	Gentlemen	4	S.
279	Shalan	—	?	3	D.
		? Daqlat Sha'lan		—	D.
		? Sha'lani		—	N.
280	Shali	—	? Piece of meat	4	S.
281	Sharhi	—	? Slice of meat	4	S.
282	Shibrawi	—	Of a span	4	—
283	Shirani	—	Sugary	3	—
284	Shirazi	—	Of Shiraz	4	S.
285	Shir Bakhti	—	? Lion's luck	4	N.
286	Shitwi	—	Of winter	2	—
287	Shukkar	—	Sugar	2	—
288	Shukkar Bahri	—	Sea sugar	4	S.
289	Shumus	—	Suns	4	—
290	Shuwaythi	? Shuwaydi	?	3	—
291	Sinn al-Miftah	—	The tooth of the key	3	—
292	Subayhi	—	? Comely	4	S.
293	Subayi	—	? Of seven	3	—
294	Suddad	—	? Large lizard	4	—
295	Sukkari	? Sukkar	Of candy	3	—
		? Daqal Sakran		—	S.
296	Sultani	—	Of a sultan	3	—
297	Suwaydan	Suwayd ?	Little blacks	3	—
298	Tabakh Ruhah	—	He cooked himself	4	—
299	Tabarzal	—	? Sugar candy	1	—
300	Tabashir	—	Chalk	4	P.
301	Taubah	—	Ball	4	—
302	Tayyar	—	? Tongue of a balance	4	S.
303	Tufahah	—	? Apple	4	—
304	Turshi Ashi	—	? Cook's pickles	4	N.
305	Ubaydi	—	Of 'Ubayd	4	—
306	Ukht al-Qasb	—	Sister of al-Qasb	4	S.
		? Ukht Badrayah			
307	Umm ad-Duhn	—	The mother of the oil	3	—
308	Umm Ajribah	—	The mother of the measure	4	P.
309	Umm al-Amul	—	? The mother of the cake	4	N.
310	Umm al-Balalis	—	The mother of the jars	3	—
311	Umm al-Baydh	—	The mother of the eggs	4	—
312	Umm al-Bukhur	—	The mother of the frankincense	3	—
313	Umm al-Idham	—	The mother of the bones	3	—
314	Umm al-Jamus	—	The mother of the buffalo	4	S.
315	Umm al-Khayr	—	The mother of the wealth	4	S.
316	Umm al-Kibar	—	The mother of the capers	4	S.

PROVISIONAL LIST.—(*Contd.*)

Date Palms of the 'Iraq.

No.	Name.	Synonyms.	Meanings.	Status.	Authority.
317	Umm al-Kuhl	—	The mother of the collyrium	4	C.
318	Umm al-Lauz ...	—	The mother of the almonds	4	C.
319	Umm al-Layl	—	The mother of the night	4	S.
320	Umm ar-Rihah	—	The mother of the scent	3	—
321	Umm ar-Rukuk	—	The mother of the baskets	4	S.
322	Umm As-Abi	—	The mother of fingers	4	—
323	Umm as-Salabikh	—	The mother of the stones	4	—
324	Umm as-Salasil	Umm as-Sinaysil	The mother of the chains	4	C.
325	Umm as-Saujah	—	The mother of the knot	4	C.
326	Umm as-Sini	? Umm as-Sawani	? The mother of the plate	2	—
		? Abu Sini			
		? Abu s-Sawani			
327	Umm Junayh	—	? The mother of a wing	4	S.
328	Umm Sabah Dhira	—	The mother of seven to an ell	4	—
329	Umm Sumrah	—	The mother of brown	4	S.
330	Umrayn	—	? Two generations	4	D.
331	Unayb	—	Little grapes	4	S.
332	Uqruq	—	Frogs	4	D.
333	Usta Imran	Sayir 'Amrani	Master 'Imran	1	—
334	Usta Imran Bahr	? Bahariyyah	Master 'Imrain of the sea	3	—
		? Bahri			
335	'Uwaydi	—	Of 'Uwayd	3	—
336	Uwaymiri	? 'Amiri	? Of the little cultivated	3	—
		? 'Amri			
337	Uwaynat as-Sawi	—	? Little dry eye	2	—
338	Uwaynat Ayyub	—	Job's little eye	2	—
339	Uwayni	—	? Of the little eye	4	S.
340	Uwayriyah	—	? Stripped of its fruit	4	N.
341	Warimiyyah	—	? Swollen	4	—
342	Zahdi	—	? Of a small quantity	1	—
343	Zahriyyah	—	Blossomy	4	Ch.
344	Zamili	—	? Of a follower	4	S.
345	Zand al-Abd	—	The fore-arm of the slave	4	—
346	Zaydi	—	Of Zayd	4	S.
347	Zaytuniyyah	—	? The one like an olive tree	4	C.
348	Zubayr	—	(Man's name)	4	—
349	Zubb al-Wawi	Zubayb al-Wawi	The jackal's yard	3	—
350	Zubb Rabah	—	Civet's yard	4	S.
351	Zunbur	—	Hornet	4	S.
352	Zurayyah	—	? Of a waterskin	4	—

REVIEWS.

GRUNDRISS DER TROPISCHEN UND SUBTROPISCHEN BODENKUNDE

By P. Vageler, *Verlagsgesellschaft fur Ackerbau M.B.H.*, Berlin. 1938, pp. 243, 2nd Edition.

Since the publication of the first edition of "Grundriss der Tropischen und Subtropischen Bodenkunde" nine years ago, Dr. Vageler has had the opportunity of investigating South American soils and has incorporated the results of his recent observations, with those previously made on the tropical and subtropical soils of Africa and Asia, in the second edition of his book which has been revised and enlarged. In spite of the inclusion of new data, the general arrangement of the second edition does not differ significantly from that of the first. Rather than as a text book Vageler's work should be considered as a supplement to already existing works on soil science because of the prominence given to those special problems of the tropics which are too briefly treated in general textbooks. Although in no sense a final work of reference and intended primarily for the planter and student of tropical agriculture this book will prove of interest to all who are engaged in the field of soil science.

The new book, which is divided into the same general parts found in the first edition, opens with a discussion of the theoretical and practical problems of soil science. This is followed by an account of rocks and minerals considered as the parent material of soil and in relation to soil fertility. For simplicity the chapter relating to this subject is divided into sections dealing respectively with the most important soil minerals, the most important soil-forming rocks and the secondary formation of rock in soil; simple soil-investigation methods are also included. The third chapter, devoted to forms of vegetation in the tropics and subtropics as sources of organic substances in the soil, is illustrated with several photographs. After a short section on climate, relief and vegetation in the formation of tropical and subtropical soils the author turns his attention to the physical and chemical aspect of the weathering of rocks, the conversion of organic residues in the soil into humus and the influence of this process on chemical weathering and the displacement of soil material. Also included in this chapter are the results of the author's observations in permanently moist, intermittently moist and arid tropical and subtropical regions.

As the author points out, 75 per cent. of all failures of agricultural enterprises are due mainly, if not entirely, to wrong choice of land. Accordingly the last three chapters which deal respectively with soil selection, physical aspects of the choice of crops and soil management and chemical aspects of the choice of crops and soil management should be of great value to the planter. Appended are two charts, the first a table for the determination of the most important soil minerals, the second a survey of the principal igneous rocks.

The emphasis given to the more important passages in the text, by printing them in italics, is to be commended.

Qualified both scientifically and practically for his task Dr. Vageler has presented most satisfactorily the results of his wide experience and studies of tropical and subtropical soils. Well indexed, and illustrated with 27 photographs, 2 coloured plates and 14 figures, Vageler's book will undoubtedly receive the recognition and wide circulation it deserves particularly among those who, faced by soil problems of an unexpected kind, are not in a position to apply to a research station for the necessary technical advice. It is to be hoped that an English translation of this second edition will soon be available.

H. F. B.

* * *

CITRUS INDUSTRY OF SOUTH AFRICA, ITS NATIONAL AND INTERNATIONAL ASPECTS.

By S. D. Neumark, *Witwatersrand University Press*, Johannesburg, 1938, pp. 192.

Mr. Neumark has made a careful study of the economic aspects of the South African citrus industry, and for workers in this subject his book should provide a mine of relevant information, but for the general reader his treatment is probably too detailed.

The South African citrus industry suffers severely at the hands of its main competitors in the European market since the cost of production is high while the quality of the fruit is comparatively poor. Since the cost of production is small as compared with the cost of freight the solution of the problem does not appear to lie in reducing the cost of production in order to compete in the cheaper markets so much as to raise the quality of the fruit which will then command high prices.

S. H. C.

FOOD VALUE OF SOYA BEANS.

In the United States of America and South Africa soya beans have been found to increase the milk yield if fed to dairy stock and to give excellent results in the fattening of cattle. Soya beans contain about 17 per cent. of oil and 40 per cent. of protein as well as about 20 per cent. of carbohydrate and 4 per cent. of fibre and thus provided a most valuable food for all stock.

The beans are best fed as a meal mixed with maize meal in the proportion of 1 to 5; the growing crop also provides an excellent fattening fodder and is suitable for preservation as silage or for stall feed as "chop-chop".

The beans grow well in Fiji under fair average cultivation conditions and can be supplied in very limited quantities at certain seasons of the year at prices similar to cotton seed and are well worth a trial by dairy farmers.—H.W.J.—(*Fiji Agricultural Journal*, Vol. X, No. 1. p. 26, 1939.)

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Suckers in P.O.J. Canes: Their Influence on Juice Clarification.—*By A. A. Betancount y Gonzalez.*

"It is the suckers which cause disturbances in clarification, and not normally developed canes, even though their richness may not be too high. Suckers ground during the 1937 season were extraordinarily developed vegetatively. As an average, out of seven, six resembled normally grown canes. . . . Suckers amounted in some cases to 20 per cent. of the weight of normal canes. . . . It seems likely that the small number of poorly developed suckers during the grinding season of 1937, and the rather high number of them in previous years, is the principal reason explaining the clarification troubles in juice of P.O.J. canes. . . . The question may be asked whether there is any resource at our disposal for the control of the development of suckers, which is principally affected by climatic conditions." Answers to this question are that judging by the experience of the 1936 crop, an ample and regular supply of moisture is important. Spacing is also a point for consideration. Wide spacings may give normal canes that are better developed and riper, but this increases the number of suckers. Close spacings, on the other hand, results in hardly any suckers being produced.—(*Int. Sugar Jr.*, Vol. XLI, No. 485, p. 197, 1939.)

* * *

Importance of Measuring the Water Added to the Pans.—*By J. R. Mayo, Jr.*

The theme of the author's paper is that while the imbibition water thrown on the bagasse at the milling station is carefully reported, that which is drawn into the vacuum pans, capable of amounting to a respectable total, is not generally measured. Here is what he has to say:

"Water applied to the molasses has the further disadvantage, as compared to that applied on the bagasse or to the cachazas, that it must be evaporated in single effect with the consequent increased consumption of heat per unit of water used. We can give no concrete figures, precisely because of lack of information in the mill reports, but we have observed how the pile of bagasse changes with the molasses factor, that is: plenty of bagasse with high molasses factor, lack of bagasse with low molasses factor, at the same factory, during the same crop and without appreciable change in any other factor. The approximate figures mentioned below will give an idea of the relative amount of steam required by the use of imbibition water and by the water applied to molasses, respectively. In a sugar mill grinding 380,000 arrobas (4,750 tons) with 16 per cent. dilution on the cane, approximately 500,000 lbs. of steam will be required to heat (with exhaust steam) and evaporate in quadruple-effect the dilution water contained in the juice. In the same sugar factory, with the system of boiling, the purities and polarization more usual in Cuba, there will be required about 750,000 lbs. of steam to evaporate in single effect the dilution water in the molasses.

This represents a considerable amount of heat, and it is quite possible that the use and abuse of water in the molasses may affect adversely the heat balance of a sugar factory. In comparing the work of several factories, it is noticed that the total losses are distributed in the most diverse ways. In some places the loss of sucrose is higher in the bagasse than in the molasses, while in other places the reverse happens. Some factories report 30 per cent. while others may report only 8 per cent. of imbibition water, but in none of them do we find reported the amount of water added to *cachazas* (filter-press mud) and molasses".

(C. W. Waddell also has drawn attention to the importance of measuring the added water which has to be evaporated at the pans station of a sugar factory.* Ed. *I.S.J.*).—(*Int. Sugar Jr.*, Vol. XLI, No. 485, pp. 195-96, 1939.)

* *I.S.J.*, 1938, pp. 274-275.

* * *

Report of the N.Y. Sugar Trade Laboratory. *By F. W. Zerban.*

The total number of raw sugar samples polarized was 16,611, a slight decrease from the 16,652 of the preceding year, representing an average of 2,316 packages each, against 2,367 in 1937 and 2,378 in 1936. The average polarization of all the raw sugar samples was 97.13, which is 0.01 higher than in the preceding year. The percentage of samples testing 98 and over has shown a further increase, samples from 9.69 per cent. in 1937, to 11.91 per cent. in 1938. The proportion of samples polarizing from 97 to 98 has fallen from 51.71 per cent. in 1937, to 50.04 per cent. in 1938, and that of samples polarizing from 96 to 97 has also decreased, from 33.14 per cent. to 31.59 per cent. The relative number of samples in the 95 to 96 group, after having fallen continuously for several years has risen from 4.40 per cent. in 1937 to 4.94 per cent. in 1938. The same is true of samples below 95 polarization, which have increased from 1.06 per cent. to 1.51 per cent. Contrary to expectations, the number of samples of molasses and syrups received for analysis has shown a sharp decrease, from 812 in 1937, to 515 in 1938, but this has been partially offset by a large number of special tests on sugars, syrups and molasses.—(*Int. Sugar Journal*, Vol. XLI, No. 485, p. 189, 1939.)

The Editor is prepared to consider signed articles for publication in *Tropical Agriculture*. Such articles should normally vary between 1,000 to 6,000 words and may be illustrated if desired. Rates can be obtained on application to the Editor.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Organic Carbon in Soils.—*By E. R. Purvis and G. E. Higson, Jr.*

W. T. Degtjareff (*Soil Sci.*, 1930, 29, 239) and L. E. Allison (*id.*, 1935, 40, 311) have found that, although Schollenberger's chromic acid reduction method (*id.* 1927, 24, 65; 1931, 31, 483) for the determination of organic carbon in soils does not give quantitative results as compared with the combustion method, the results are constant and reproducible, and the correct value may be obtained by the use of the factor 1.15. In the method, 0.2 to 0.5g. of soil is oxidised with a measured quantity of a standard solution of chromic acid in sulphuric acid, the extent of reduction of the reagent being determined by titration with 0.2 *N* ferrous ammonium sulphate solution, with diphenylamine as indicator. Various devices have been suggested for accelerating the oxidation reaction (*cf.* Degtjareff, *loc. cit.*, and Walkley and Black, *id.*, 1934, 37, 29), but they are shown to impair the accuracy of the method. In particular, this is now proved to apply to Degtjareff's proposal (*loc. cit.*) that the mixture should be heated for ten minutes at 165°C. in a bath of sulphuric acid, the titre of the chromic acid being reduced by 0.008 and 0.072 *N* when temperatures of 140° and 180°C. are used. This is due to both evaporation and reduction of the chromic acid in contact with the glass container, parts of which may attain a temperature of 800°C. over an open flame. The authors therefore suggest balancing the temperature and the period of heating, so as to render negligible the change in strength of the reagent. An electric oven suitable for this purpose is described; it accommodates ten test-tubes (25 × 150 mm.) and is capable of operating at 400°C., and of raising the temperature of the 10 ml. of solution in each test-tube to 175°C. in about three minutes. If the top two-thirds of the test-tubes project out of the oven, and so act as a condenser, this and the fact that the actual glass does not attain a temperature over 400°C. minimise the loss in strength of the solution. Tests on five soils containing 0.65 to 5.22 per cent. of organic matter, showed that the results after oxidation for three minutes were the same as those obtained by heating over the open flame for 90 seconds; thus 100 samples may be oxidised in an hour. The reagent is best prepared by heating for one hour on the water-bath, with occasional stirring, a mixture of 10g. of powdered potassium dichromate (which has previously been dried at 100°C. for one hour) and 500 ml. of a mixture of equal volumes of phosphoric acid and sulphuric acid. This produces a reagent approximately 0.4 *N* in (oxidising) strength and of maximum stability; there is no necessity to add phosphoric acid subsequently to activate the diphenylamine indicator; the stated proportions of acids ensure the sharpest end-point. (*The Analyst*, Vol. LXIV, No. 756, pp. 221-22, 1939.)

Strength of Pectin Gels from Various Sources.—*By L. H. Lampitt and R. W. Money.*

The pectin from various fruits, ripe or unripe, is prepared by submitting the chopped or pulped fruit directly to autoclaving and filtration, and the juice or extract is partly purified by three precipitations from water with 70 per cent. alcohol. The precipitated pectin is separated, washed with acetone and finally air-dried, and a five per cent. solution in water of the powder used. If the "leaching" method is used in the preparation, a great deal of the pectin of ripe fruits is lost. Neither method produces an ash-free pectin, for which recourse must be had to dialysis. The alcohol precipitation is fairly effective in removing organic impurities, *i.e.* acids and sugars. The gel strength was measured by the torsion apparatus previously described (*J. Soc. Chem. Ind.*, 1936, 55, 88T). There is a very great difference in strength of gel given by the various pectins; *e.g.*, to give a strength equal to 100 angular degrees, the equivalent concentrations of pectins were: apple, 100; gooseberry, 158; raspberry, 300; plum, 364; black currant, 400. The linear relationship of strength to pectin concentration (*J. Soc. Chem. Ind.*, 1937, 56, 290T), previously recorded for gelatin and for pectin, was observed in every instance, but considerable variations in the slopes of the lines were noted, perhaps owing to the presence of compounds estimated as calcium pectate, but possessing differing powers of gel formation. Although for apple pectin the slope is independent of the pH value and of the sugar concentration, with raspberry, plum, and particularly black currant, the slope is apparently dependent on the pH value. With apple pectin the gel strength increases to a maximum as acidity is increased, but with other pectins a continuous increase in strength with increasing acidity is observed over the range employed. When the sugar concentration in the gels varied from 55 to 80 per cent., with apple pectin the curve appeared to tend towards a maximum, owing to increased rate of setting, whereas with the other pectins no such tendency was found. It is to be expected that the compounds associated with the true pectin will vary owing to different degrees of ripeness of the fruit, and such compounds may also be the cause of anomalies in the experiments on effects of acidity and sugar concentrations, and differences in rate of setting of the pectins.—(*The Analyst*, Vol. LXIV, No. 756, pp. 202-03, 1939.)

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TREND OF THE MARKETS.

[The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.]

SUGAR.—Prices on the Home Market have ranged as follows (c.i.f. per cwt.) :—

	Foreign.		*Preferential.*	
	s.	*d.*	*s.*	*d.*
27th April ...	7	10½	11	7½
4th May ...	8	4½	12	0
11th May ...	8	4½	12	1½
18th May ...	8	3	12	0
25th May ...	8	0	11	6
1st June ...	7	6	11	9
10th June ...	8	3	11	0
(10th June, 1938) ...	5	0	8	11¾

After a further sharp advance in prices the market received a severe check by the announcement that the Executive Committee of the International Sugar Council would meet to examine the question of supplies and requirements during the balance of the current Convention period. It is expected that recommendations will be made for the release of additional quotas and until some very definite announcement is made not only on this point but also on the extent to which supplies are likely to materialise it is probable that the market will remain unsettled. The present shortage of supplies which is estimated at about 225,000 tons has been brought about by the very poor yield of the European beet and Indian cane crop, the failure of some countries to export all their quotas and the accumulation of large emergency stocks by Governments.

* * *

RUBBER.—Quotations for Plantation Sheet have ranged as follows :—

	Pence per lb.
26th April	7 15/16
3rd May	7 15/16
10th May	8
17th May	8 1/16
26th May	8 3/16
2nd June	8 5/16
7th June	8 1/4
(8th June, 1938)	5 11/16

Since our last Report the market has been rather inactive and there have been only minor fluctuations. American consumption for April was up to expectations at 44,166 tons. The International Regulation Rubber Committee at a recent meeting decided to increase the export quota to 55 per cent. of the basic tonnage which will mean an addition to shipments of about 6,000 tons which should cause no difficulties to the market.

* * *

BANANAS.—The demand for Jamaicas has remained moderate to fair with prices unchanged at £19 10s. delivered London and £19 5s. delivered nearest station Provinces. Brazilians are still in fair demand and prices have increased to £16 delivered both London and Provinces.—(*West India Committee Circular*, 18th May, 1939.)

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association.

	American Mid.	*Egyptian Giza.*	*F.G.F. Sakel.*
28th April ...	5.00	6.38	6.38
5th May ...	5.28	6.39	6.39
12th May ...	5.33	6.29	6.29
19th May ...	5.54	6.62	6.52
26th May ...	5.48	6.61	6.51
2nd June ...	5.49	6.67	6.57
10th June ...	5.77	—	—
(10th June, 1938)	4.54	6.66	7.26

The better feeling prevailing in the market previously reported has continued. There has been a further recovery in raw cotton prices for the opinion is gaining ground that the export subsidy plan in U.S.A. will be abandoned. A moderate business has been done in West Indian Sea Island cotton and prices are firm.

* * *

COCOA.—During the past month cocoa prices remained about unchanged. The market fluctuated within a narrow range with trading extremely limited. This was due to the continued absence of interest from speculative circles and rather meagre buying on the part of manufacturers. Crop reports from Accra estimate stocks at 57,000 tons and advices from Bahia state that further trades have been concluded with Germany on a barter basis the contract price being well above the New York market. New crop Accra is quoted at 22*s.* 3*d.* c.i.f. and locally $8.00 a fanega is paid for Plantation marks.—(*By courtesy of the Cocoa Planters' Association of Trinidad, Ltd.*)

* * *

SPICES.—*Pimento.*—More business has been transacted and prices are well maintained on the steady absorption of stock into consumers' hands. The present value is 72*s.* 6*d.* c.i.f. Havre for orders for May shipment. Small sales have been made on the spot in London around 7 7/8*d.* per lb. ex store. *Ginger.*—The present value of Jamaica on the spot in London is 27*s.* 6*d.* to 36*s.* 6*d.* for small mixed No. 3 to medium bright No. 2. New Crop No. 3 has been sold at 25*s.* c.i.f. London for prompt shipment from Jamaica, the closing sellers' price being 26*s.* *Nutmegs* have developed a better market on more support from the home trade as well as inquiries from London exporters. Wormy and broken are quoted at 2 7/8*d.*; sound unassorted at 4½*d.* to 4¾*d.*; sound 80's at 5½*d.* to 6*d.* *Mace* is quiet though in better demand with business passing on the spot around 1*s.* 6*d.* for mixed red to pale; fine pale is quoted at 1*s.* 8*d.* —(*West India Committee Circular*, 18th May, 1939.)

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COPRA.—Market steady, with West Indian f.m.s. valued higher for July-August at £11 15*s.*